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Interleukin 8: Changes in Paroxysmal Atrial Fibrillation

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Authors' contributions

The work was carried out in collaboration between all authors. Author MN collected the blood samples, performed the statistical analysis and wrote the first draft of the manuscript. Authors SG and KV designed the study and analyzed the results. Authors MN and DA managed the literature research. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To study the levels of interleukin-8 (IL-8) in patients with paroxysmal atrial fibrillation (occurred in <48 hours) and track the changes after restoration of sinus rhythm.
Study Design: Prospective.
Place and Duration of Study: The study was conducted in the Intensive Cardiology Department of the First Cardiology Clinic at the University Hospital "St. Marina "- Varna for the period October 2010 – May 2012.

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Methodology: We included 51 patients (26 men, 25 women; mean age 59.84±1.60 years) with paroxysmal atrial fibrillation and 52 controls (26 men, 26 women; 59.50±1.46 years) with no history of atrial fibrillation. The two groups matched by age, gender and clinical characteristics. Patients' plasma concentrations of IL-8 were measured three times: immediately after admission to the ward (baseline values), twenty-four hours and twenty-eight days after rhythm restoration. In the control group the indicator was tested once. IL-8 was measured using an ELISA kit. In all patients the arrhythmia episode was discontinued by the administration of propafenone.
Results: All patients were hospitalized between the second and the twenty-fourth hour after the onset of the arrhythmia, and most frequently in the fifth hour (10 of all 51 patients). Baseline values of IL-8 were increased compared to those of the controls (77.38±3.78 vs 32.18±1.54 pg/mL, p <0.001). Twenty-four hours after restoration of sinus rhythm, IL-8 concentrations were still significantly higher (65.33±3.29 vs 32.18±1.54 pg/mL, p <0.001). On the twenty-eighth day there was no significant difference (28.07±1.68 vs 32.18±1.54 pg/mL, p = 0.07).
Conclusion: Plasma concentrations of IL-8 are significantly elevated in the early hours of the clinical manifestation of paroxysmal atrial fibrillation as well as after the arrhythmia discontinuation. Their restoration occurs slowly over time. The established specific dynamics in IL-8 concentrations suggests a close relationship between paroxysmal atrial fibrillation and inflammation.

Keywords: Interleukin-8; inflammation; atrial fibrillation; sinus rhythm.

1. INTRODUCTION

Atrial fibrillation (AF) is the most common arrhythmia in clinical practice affecting > 1% of the general population [1]. There is an increasing interest in recent years in paroxysmal atrial fibrillation (PAF), recurrences of which are associated with electrical and structural remodeling of the atria and subsequent chronification of the rhythm disorder or in short "AF begets AF" [2]. PAF constitutes between 25 and 60% of all cases of AF, and it is even considered that the actual prevalence is higher due to the presence of asymptomatic episodes [3]. In PAF the risk of stroke and thromboembolic complications is not less than the risk of other forms of arrhythmia, including permanent AF [4].

The mechanisms involved in the manifestation and clinical course of the disease are complex and still not fully understood. More and more data is being accumulated on the presence of a link between PAF and inflammation. For example, histological studies have found that the development of PAF is associated with local inflammatory changes in the atrial myocardium [5,6]. It is believed that in their base lies leukocyte activation [7]. In turn, it is a direct result of the potency and duration of action of the main inflammatory modulators, namely cytokines and chemokines [8]. It is in this sense that they are considered to have a leading role in the occurrence and recurrence of PAF. For that reason their research is a challenge for modern cardiology and could give an answer to a number of questions related to the treatment of the disease.

Studies have already found increased levels in certain cytokines from the inflammatory cascade such as TNF-α, IL-6, IL-15 and IL-18 in patients with PAF [9-13]. However, studies on the plasma levels of IL-8 are still rare. Moreover, the results presented in those studies are somewhat contradictory. For example, according to the survey of Liuba et al. [14] of patients with PAF, the levels of the inflammatory markers studied including IL-8, are not elevated. Unlike PAF, however, the permanent AF is associated with a significant increase of the indicator. These results allow the authors to express an assumption that there is no relation between the inflammatory response and the expression of PAF. They found such relation in long-lasting AF. Contrary to these results, de Gennaro et al. [15] found that brief episodes of PAF are characterized by high levels of IL-8. Analyzing the design of the studies it is appropriate to note that the indicator has only been studied once. There are still no clinical studies with a sufficiently long period of observation to outline the nature of the identified changes and to allow for a causal relationship between PAF and inflammation.

2. PURPOSE

To study the levels of IL-8 in patients with PAF (occurred in <48 hours) and track the changes after restoration of sinus rhythm.

3. MATERIALS AND METHODS

3.1 Study Population

Only patients with PAF with a rhythm disorder which occurred in <48 hours prior to hospitalization were screened for the study. This allowed for an acute medication attempt for rhythm regularization.

The beginning of the rhythm disorder was accurately determined based on detailed medical history where patients determined the onset of AF as a sudden occurrence of a subjective feeling of "palpitation", continuing until hospitalization. The diagnosis "atrial fibrillation" was accepted after being objectified by electrocardiographic examination performed immediately after the hospitalization of the patients.

From a total of 338 screened, only 56 participants were selected (31 men, 25 women) with restored and permanently retained sinus rhythm until the end of the study. 282 patients with PAF were dropped due to exclusion criteria (see exclusion criteria).

Two control examinations were carried out after hospital discharge on the seventh and twenty-eighth day after discontinuation of the arrhythmia, during which the performed ECG records and detailed medical history did not reveal any recurrence of the rhythm disorder.

To balance the gender structure, 51 patients were successively selected (26 men and 25 women) with a mean age 59.84±1.60 years (31-77 years).

3.1.1 Exclusion criteria for the study

i) Cardiovascular diseases, namely: ischemic heart disease, heart failure; inflammatory or congenital heart diseases, moderate or severe acquired valvular diseases; cardiomyopathies.
ii) Other diseases – renal, pulmonary or liver failure; diseases of the central nervous system; inflammatory and/or infectious diseases for the previous three months; neoplastic or autoimmune diseases; diseases of the endocrine nervous system (except for diabetes mellitus type 2, non-insulin dependent).
iii) Intake of hormone-replacement therapy or contraceptives; pregnancy; systematic intake of analgesics, incl. non-steroidal anti-inflammatory drugs; BMI>35.
iv) Persistence of the rhythm disorder after propafenone application, rhythm regularization by electrical cardioversion, recurrence of the AF till the end of the study (exclusion criteria for patients).

In compiling the control group the same exclusion criteria were applied (see above), since the selection of the participants (patients and controls) aimed to a maximal degree to eliminate or equalize between the two groups the factors influencing inflammation. Thus, from a total of 169 screened, 52 were selected as controls for the study. Their mean age was 59.50±1.46 years (30-76 years) and men and women were an equal number – 26 (50%). Prior to the study the controls had no history or electrocardiographic evidence of AF.

3.2 Study Design

Patients' IL-8 levels were determined three times: Immediately after admission to the ward (baseline values), twenty-four hours and twenty-eight days after rhythm restoration. In the control group the indicator was tested once.

Patients were discharged twenty-four hours after interruption of the rhythm disorder. All of them were monitored for a period of 28 days after rhythm regularization.

The study was conducted in the Intensive Cardiology Department of the First Cardiology Clinic at the University Hospital "St. Marina "- Varna for the period October 2010 – May 2012 after approval by the Ethics Committee of Scientific Research (№35/29.10.2010) at the same hospital and in compliance with the Declaration of Helsinki [16]. Participants were included in the study after previously signing an informed consent for participation.

3.3 Therapeutic Scheme of Propafenone

Propafenone was administered according to its prescribed scheme: i.v. 2 mg/kg bolus, followed by an infusion at a dose of 0.0078 mg/kg/min for 120 min and p.o. administration at a dose of 300 mg three times at an interval of 8 hours [17,18]. In restored sinus rhythm the scheme was discontinued, and until the end of the study all patients received a maintenance dose of p.o. 150 mg three times daily. All patients were continuously monitored until hospital discharge.

3.4 Collection and Storage of Blood Samples. Study of IL-8

Venous blood was collected in a heparin vacutainer (VACUETTE/4.0 ml/Li Hep) and immediately centrifuged. Subsequently the resulting plasma was frozen. Collection and storage of samples was carried out in full accordance with the methodology used.

Re-freezing of samples was not allowed during the conducting of the study.

Plasma concentrations of IL-8 were measured using a commercially available ELISA kit (Elabscience Biotechnology Co., Ltd, China). The Elisa was carried out according to the manufacturer's protocol. All measurements were done in duplicate. The coefficient of variation was <10%.

3.5 Statistical Analysis

Using descriptive statistics, averages, relative shares and central tendency (Mo=mode) were calculated. The testing of the hypothesis for equality of averages and indicators of relative share was done using Student's t-criterion. Values of $P < .05$ were considered statistically significant.

The analysis of all data was performed by a specialized statistical analysis package GraphPad PRISM, Version 5.00. The results were presented as mean±standard error of the mean (SEM) or n(%).

4. RESULTS

4.1 Clinical Characteristics of Patients and Controls

The clinical characteristics of the group with PAF were statistically identical to that of the controls ($P > .05$) (Table 1).

The performed statistical analysis of the time from the onset of AF until hospitalization showed that all 51 patients were hospitalized between the second and the twenty-fourth hour after the onset of the arrhythmia, and most frequently in the fifth hour (Mo=5, 10 of all 51 patients). The mean duration of the episodes of AF prior to hospitalization was 8.14±0.76 hours (from a minimum of 2 hours to a maximum of 24 hours).

4.2 Concentrations of IL-8

Fig. 1 shows that baseline plasma concentrations of IL-8 in patients were increased compared to those of controls (77.38±3.78 vs 32.18±1.54 pg/mL, $P< .001$). Twenty-four hours after restoration of sinus rhythm, the measured values of IL-8 were still significantly higher than in controls (65.33±3.29 vs 32.18±1.54 pg/mL, $P< .001$). On the twenty-eighth day there was no significant difference in the values in patients and controls (28.07±1.68 vs 32.18±1.54 pg/mL, $P= .07$).

5. DISCUSSION

Statistical processing of our data showed significant differences in plasma concentrations of IL-8 in patients and controls (Fig. 1). In the samples taken immediately after hospitalization, the levels of IL-8 in patients with PAF were much higher ($P< .001$). As noted in the *Results* section, they were tested in the first hours of the clinical manifestation of the disease (up to the twenty fourth hour). The early and significant increase of IL-8 gives serious grounds to assume that the identified changes are closely related and specific to PAF and not an accidental laboratory finding. In this sense, the clinical characteristics of the participants are essential for the results. The low burden of diseases (Table 1) eliminates their potential effect on IL-8 plasma concentrations. Moreover, the identity of the patient and control groups in terms of the following indicators: age, sex, BMI, bad habits, comorbidities and their treatment, gives an opportunity to accurately consider the net effect of PAF on the studied indicator. At the same time this makes the comparison between the groups as objective as possible.

Chemokines are key components of the inflammatory response due to their ability to attract and activate various subpopulations of white blood cells [19]. IL-8 is the prototypical chemokine of the CXC subfamily, which is characterized by a single amino acid separating the two amino-terminal cysteine residues of the protein [20]. It plays an important role in inflammation and its function is associated with attraction and activation of the fundamental for the inflammatory response cells, namely monocytes and neutrophils [21]. This establishes IL-8 as a leading pro-inflammatory cytokine [22]. Its elevated concentrations are a sign for activation of the inflammatory process. In this sense, the high baseline concentrations of IL-8

measured in our study show increased pro-inflammatory processes even in the early hours of the clinical expression of the disease.

Despite the key role of IL-8 in the inflammatory cascade, studies on IL-8 are single. Li et al establish changes which are unidirectional to our study [12]. In their study, the once measured levels of IL-8 in patients with PAF were significantly elevated relative to controls. Conversely, the results of Luiba et al. did not show a statistically significant difference in the levels of IL-8 in patients with PAF and controls [14]. The contradictory results confirm the necessity of the conducted by us study.

Twenty-four hours after restoration of the sinus rhythm, the established changes in the levels of IL-8 during hospitalization were retained (Fig. 1). PAF patients showed again increased levels of the studied indicator. This result is to a large extent expected given the specific characteristics of interleukin. It is known that it is synthesized very early in the inflammatory response and remains active at the site of inflammation over a long period of time, for days and weeks [23]. Thus, the inflammatory process appears to be activated not only during the paroxysmal episodes of AF but also after them. This fact gives us ground to consider that inflammatory changes in the myocardium cumulate even in sinus rhythm. Elimination of the arrhythmia is not an equivalent to elimination of the pathophysiological processes associated in AF clinical course. Decreased IL-8 levels, statistically insignificant when compared to controls, were measured yet on the twenty-eighth day after restoration of sinus rhythm. The inflammatory activity was reduced, though this was reported late after the rhythm restoration.

Table 1. Characteristics of patients' and control group

	Patients with PAF	Control group	P values
Number of participants in the group	51	52	*P*= .89
Mean age (years)	59.84±1.60	59.50±1.46	*P*= .87
Men/Women	26/25	26/26	*P*=1/*P*= .93
Accompanying diseases			
Hypertension	37 (72.54%)	34 (65.38%)	*P*= .44
Diabetes mellitus type 2	3 (5.88%)	2 (3.84%)	*P*= .62
Chronic ulcer disease	2 (3.92%)	0	*P*= .15
Status after hysterectomy	2 (3.92%)	1 (1.92%)	*P*= .54
Benign prostatic hyperthrophy	1 (1.96%)	0	*P*= .32
Dyslipidemia	4 (7.84%)	3 (5.77%)	*P*= .69
Medicaments for hypertension and dyslipidemia			
Beta blockers	19 (37.25%)	17 (32.69%)	*P*= .62
ACE inhibitors	15 (29.41%)	14 (26.92%)	*P*= .78
Sartans	11 (21.57%)	9 (17.31%)	*P*= .58
Statins	4 (7.84%)	3 (5.77%)	*P*= .69
Deleterious habits			
Smoking	8 (15.69%)	7 (13.46%)	*P*= .75
Alcohol intake	7 (13.72%)	6 (11.53%)	*P*= .74
BMI (kg/m^2)	23.85±0.46	24.95±0.45	*P*= .09
Echocardiographic measurements			
LVEDD (mm)	52.57±0.58	52.29±0.57	*P*= .73
LVESD (mm)	34.43±0.56	34.73±0.48	*P*= .69
EF (%)	62.98±0.70	61.54±0.58	*P*= .12
IVS (mm)	10.37±0.23	9.92±0.26	*P*= .20
PW (mm)	10.24±0.21	9.73±0.28	*P*= .16
LA обем (ml/m²)	22.81±0.45	23.82±0.48	*P*= .13
RVEDD (mm)	30.54±1.58	29.17±1.52	*P*= .18

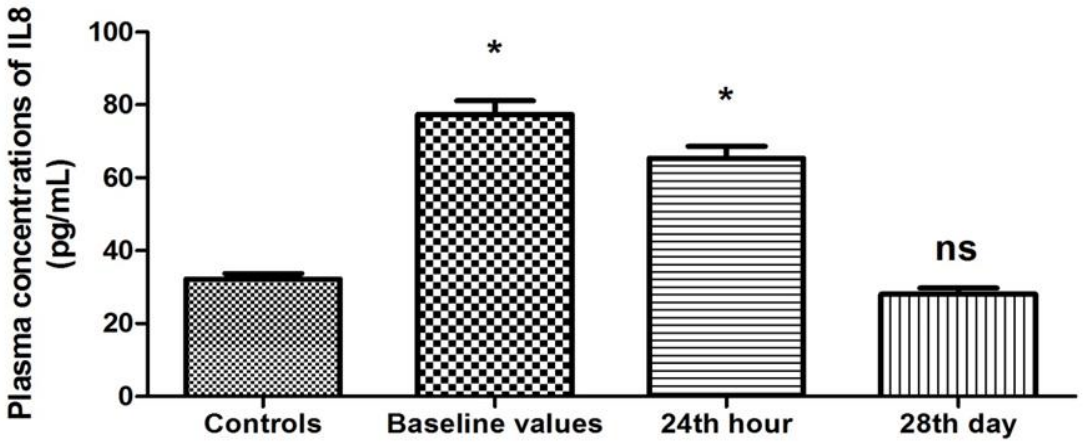

Fig. 1. Changes in plasma concentrations of IL-8 (pg/mL) in patients with PAF
*(baseline values – values upon patients' hospitalization; 24th hour – values 24 hours after rhythm regularization; 28th day - values 28 days after rhythm regularization; *- P< .001; ns – statistically insignificant difference)*

6. CONCLUSION

IL-8 is an important pro-inflammatory marker. Its levels are significantly elevated in the early hours of the clinical manifestation of the disease and persist after rhythm regularization. Their restoration occurs slowly over time. The established specific dynamics in IL-8 concentrations suggest a close relationship between the intimate mechanisms of PAF appearance and the inflammatory process.

CONSENT

All authors declare that written informed consent was obtained from all participants of the study.

ETHICAL APPROVAL

The study was approved by the Ethics Committee of Scientific Research (№35/29.10.2010) at "St. Marina" hospital Varna and was also performed in compliance with the Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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