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Temperament, stress, and atrial fibrillation

***Abstract**: In some patients with atrial fibrillation (AF), the causative agent of attack is stress (AF associated with adrenergic activity). In others, AF usually begins during relax or sleep (AF associated with vagal nerve dominance). This study aimed to investigate the individual factors associated with the adrenergic or vagal type of AF. This study included 138 patients with paroxysmal atrial fibrillation (AF). Sixty-eight patients reported that AF was frequently triggered by stress (sympathetic-type AF) and 70 patients reported that AF usually began during relaxation or sleep (vagal-type AF). Gender, age, ejection fraction, and temperament were compared across the two groups. Temperament was evaluated using the Formal Characteristics of Behaviour-Temperament Inventory. The groups differed only in temperament. Patients with sympathetic-type AF had a higher score for emotional reactivity (p = 0.002) and perseverance (p = 0.002) temperament traits and a lower score for endurance (p = 0.003) than patients with vagal-type AF and than the average in population.*
***Key words:** Temperament, atrial fibrillation, autonomic nervous system, stress.*

Atrial fibrillation (AF) is an arrhythmia that eliminates the physiological sinus rhythm, resulting in an irregular and often rapid heart rate. During AF, the atria beat chaotically and irregularly, out of coordination with the ventricles. The patient may feel palpitations, weakness, light-headedness, anxiety, sweating, chest pain, and fatigue. AF may be paroxysmal when the arrhythmia occurs suddenly, and after a few minutes or hours the heart returns to a normal rhythm on its own. If AF is present long-term and the heartbeat has not reverted back to a normal rhythm, it is considered permanent.

AF is the most common arrhythmia. In 2010, AF occurred in 8.8 million people in the European Union. This number is anticipated to reach 10.7 million by 2020 and 17.1 million by 2050 (Krijthe et al., 2013). This increase is due to the increasing incidence of AF with age, and the increasing number of elderly people in the population. AF may be associated with other diseases of the heart, such as cardiomyopathy and valvular or ischemic heart disease, diseases of other organs, or systemic disorders, such as metabolic or electrolyte disturbances, obesity, diabetes, and chronic obstructive pulmonary disease. AF can also occur in the absence of other illnesses, known as "lone AF" (Camm & Obel, 1996).

The autonomic nervous system is heavily involved in the initiation, maintenance, and perpetuation of AF. This is due to the fact that changes in autonomic tone influence atrial electrophysiological properties (Park et al., 2012). In patients with organic heart disease, AF is typically associated with sympathetic activity. In patients with lone AF, paroxysms often appear to be vagally dependent, but can also be sympathetically dependent (Chen & Tan, 2007). Changes in the activity of the autonomic nervous system in the period preceding the start of an AF attack have been confirmed in studies using Holter monitoring and spectral analysis of heart rate variability (HRV) (Huang et al., 1998, Lombardi et al., 2004).

The association between the sympathetic and parasympathetic subsystems of the autonomic nervous system and AF may explain the fact that paroxysms occur in different circumstances in sympathetic and vagal type AF. Vagal-type AF usually occurs during sleep, relaxation, or after heavy eating and drinking (sometimes a particular type of drinking), whereas sympathetic-type AF usually occurs as a result of emotional or physical overload (Hansson, Madsen-Härdig & Olsson, 2004; Mandy et al., 2012). Sometimes strong emotional stress that causes a rapid change in autonomic tone can be a trigger for AF (Legallois

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et al., 2013). Even emotions connected with sporting events can affect the occurrence of AF, as demonstrated by a study conducted in Germany during the 2006 FIFA Football World Cup (Wilbert-Lampen et al., 2008).

The association between personality traits and AF has also been examined. In longitudinal studies conducted as part of the Framingham Offspring Study (Eaker et al., 2004), a group of 3873 persons was observed over 10 years and episodes of cardiovascular disorders, including AF, were recorded. These studies showed that anger and hostility are important risk factors for AF in men, particularly men of a young age. Other studies have indicated a significant role of the type A behaviour pattern and acute life stress in AF (Mattioli et al., 2005). In addition, anxiety, anxiety sensitivity, and tendency to panic disorder increase the risk of AF (Frasure-Smith et al., 2012, Cheng et al., 2013). However, previous studies have not examined the relation between patient characteristics and the nature of AF.

The Regulative Theory of Temperament (RTT) (Strelau, 1996) ascribes temperament to formal characteristics of behaviour present since early infancy in humans and animals. It takes into account the biological background of temperament characteristics, as well as possible changes in temperament characteristics due to biologically determined life-span variation and individual-specific interaction with the environment. The RTT distinguishes six temperament traits: (1) Briskness, the tendency to react quickly, to maintain a high tempo of performing activities, and to shift easily in response to changes in the surroundings from one behaviour (reaction) to another; (2) Perseverance, the tendency to continue and to repeat behaviour after the cessation of the stimuli (situations) that evoked the behaviour; (3) Sensory sensitivity, the ability to react to sensory stimuli of low stimulative value; (4) Emotional reactivity, the tendency to react intensively to emotion-generating stimuli, expressed in high emotional sensitivity and in low emotional endurance; (5) Endurance, the ability to react adequately in situations that demand long-lasting or high stimulative activity and under intensive external stimulation; and (6) Activity, the tendency to undertake behaviour that provides a high level of stimulation (Strelau, 1996, p.135).

Considering Emotional reactivity, Endurance and Activity, four temperament types can be distinguished, differing potential for stimulating proccesing and harmony:

1. sanguine - high potential for stimulating proccesing and high activity;
2. melancholic - low potential for stimulation processing and low activity;
3. phlegmatic - high potential for stimulation processing and low activity;
4. choleric - low potential for stimulation processing and high activity.

Sanguines and melancholics represent the temperament in harmony - their activity level is adequate to the potential for stimulation processing, while the phlegmatics and cholerics have temperament not in harmony (Strelau, 2014).

According to the RTT, temperament is biologically determined. The formation of its characteristics is dependent on neurophysiological and biochemical factors. The significant role of the autonomic nervous system is emphasized, especially in the regulation of energy aspects of behaviour. For this reason, the RTT can be a theory inspiring for study seeking the relationship between psychological characteristics and the functioning of the circulatory system.

This aim of this study was to investigate whether the temperament of individuals with stress-triggered AF is different to the temperament of individuals with AF that is not associated with stress. We analysed the relation between temperament traits that are, to a large extent, conditioned biologically and the nature of AF episodes in patients with paroxysmal AF.

Methods

Participants

This study involved 138 patients with paroxysmal AF confirmed by Holter monitoring, who were prepared for treatment by radiofrequency ablation. Only patients with lone AF, i.e., without organic heart disease and other significant disease, were included. The study group comprised 97 men and 41 women, aged from 26 to 69 years.

Methods

Temperament was evaluated using the Formal Characteristics of Behaviour-Temperament Inventory (FCB-TI), which was developed based on the RTT. The FCB-TI contains 120 statements about behaviour. The examined person responds “yes” or “no” according to whether or not the statement matches his/her behaviour. Each statement is assigned to one of the six temperament traits described in the RTT (Strelau & Zawadzki, 1995). The results of each scale were standardised in the national population and scaled to stanine scores (on a nine –point standard scale with a mean of five and a standard deviation of two). Since the conversion of the raw to standardized results is closely related to age and sex and the study group in terms of these characteristics was mixed, in further analysis the standardized results were used.

Patients also filled out a brief questionnaire on AF that asked the following questions: (1) When are symptoms present?, (2) In which situation does AF appear most frequently? (sleep, relaxation, exercise, stress, alcohol consumption, or heavy eating), and (3) How frequently does AF occur? (daily, several times a week, no more than a few times a month, or less than once a month).

Statistical analysis

The patients were divided into two groups according to their response to Question 2 on the AF questionnaire. Patients who responsed “stress” were classed as sympathetic-type AF and patients who responsed “sleep” and/or “relaxation” were classed as vagal-type AF. The $\chi 2$

test and Student's t-test were used to compare duration of disease, frequency of AF symptoms, ejection fraction and FCB-TI stanine score for each temperamental traits between the two groups. The χ^2 test was also used to analyze the distribution of the four types of temperament in patients with sympathetic and vagal-type AF. All statistical analyses were performed using STATISTICA software.

Results

There were 68 patients in the sympathetic-type AF group and 70 in the vagal-type AF group. The groups did not differ in terms of gender, age, duration of disease, frequency of AF episodes, or ejection fraction (Table 1).

The temperament traits profile differed between the groups (Table 2). The FCB-TI stanine scores for Emotional reactivity (p = 0.002) and Perseverance (p = 0.002) were higher in the sympathetic-type AF group than in the vagal-type AF group, and the FCB-TI stanine score for Endurance was lower in the sympathetic-type AF group than in the vagal-type AF group (p = 0.003).

The results for these three variables in the sympathetic-type AF group also differed significantly from the average in the population. In the vagal-type AF group in the Briskness scale significantly higher average than the average in population was found.

It was examined, whether the nature of AF is associated with the types of temperament. Both vagal-type AF and sympathetic-type AF occurred in patients with all four types of temperament, however, the frequency distribution of AF types was different. In the Melancholic and Phlegmatic groups the sympathetic-type AF predominated, while in Sanguine and Choleric the vagal-type AF prevailed (*chi2* = 7.91; p = 0.05; Figure 1 - See next page).

This result suggested that the groups with two types of AF differ primarily in potential for stimulating proccesing. This conclusion was confirmed by comparing the two groups: with low (Emotional Reactivity > Endurance) and high potential for stimulating proccesing (Emotional Reactivity < Endurance). These groups significantly differed in the type of AF (*chi2* = 7.32; p = 0.006). Harmony did not differentiate the groups with two types of AF (*chi2* = 0.54; p = 0.46).

Table 1. Characteristics of patients with sympathetic-type AF and vagal-type AF

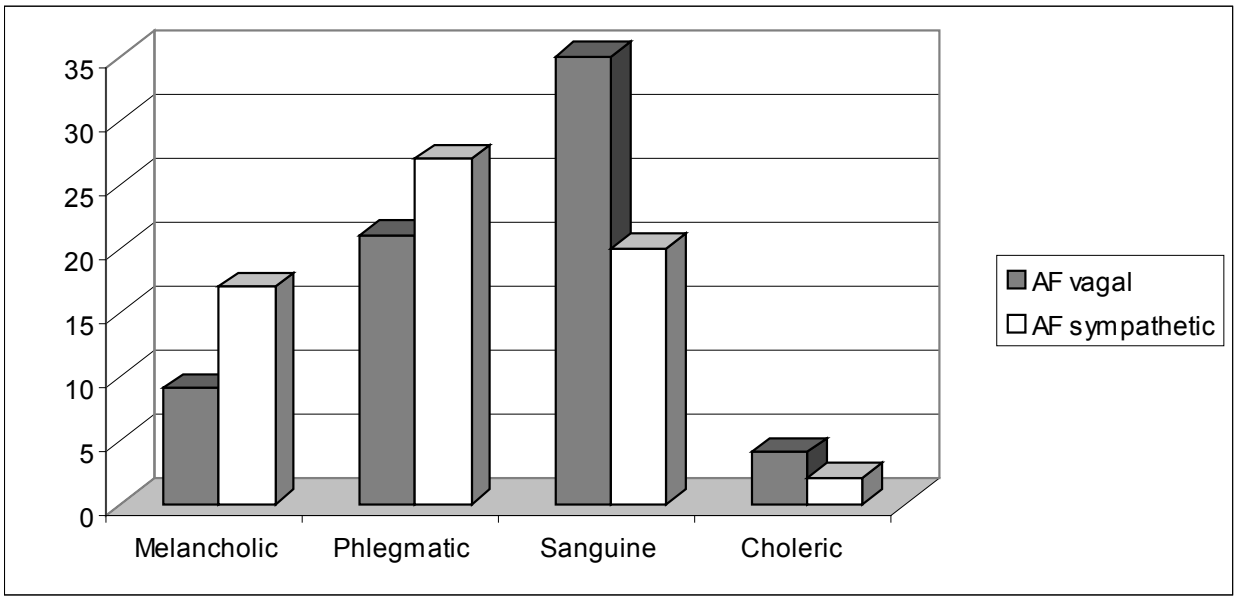
	Sympathetic-type AF	Vagal-type AF	*p*
Gender distribution			0.94
Men	48 (49.5%)	49 (50.5%)	
Women	20 (48.8%)	21 (51.2%)	
Age (years)	54.5 (*SD* 10.18)	54.4 (*SD* 10.66)	0.94
Duration of illness (years)	8.83	9.92	0.53
Frequency of paroxysmals			0.60
Daily	16 (23.4%)	23 (32.6%)	
Several weekly	33 (48.9%)	29 (41.3%)	
Several monthly	19 (27.7%)	18 (26.1%)	
Ejection fraction	63.13 (SD 7.07)	64.94 (SD 6.71)	0.26

Data are n (%) or mean (standard deviation).

Table 2. FCB-TI stanine score in vagal-type AF and sympathetic-type AF

	vagal-type AF			sympathetic-type AF			vagal/sympathetic difference	
	mean	*SD*	comparison with the average in the population, *p*	mean	*SD*	comparison with the average in the population, *p*	*t*	*p*
BR	5.53	1.88	**0.021**	4,99	1.99	0.97	-1.65	0.10
PE	4.74	2.05	0.29	5,78	1.73	**0.0005**	3.17	**0.002**
SS	4.90	1.82	0.65	5,10	2.15	0.70	0.60	0.55
AC	5.06	1.87	0.79	4,94	2.16	0.82	-0.34	0.74
ER	4.61	1.77	0.07	5,63	1.91	**0.009**	3.22	**0.002**
EN	4.80	2.12	0.43	3,81	1.69	**0.0000**	-3.03	**0.003**

Figure 1. Temperament and AF types



Discussion

This study showed that the characteristics of temperament were associated with the type of AF paroxysms. Patients who reported that AF most frequently occurred during stress (sympathetic-type AF group) had higher Emotional reactivity and lower Endurance than patients who reported that AF most frequently occurred during rest and relaxation (vagal-type AF group).

The persons with high Emotional reactivity and low Endurance have a less potential for stimulating proccesing, so they are easily disrupted by situations perceived as difficult, related to negative emotions. This can be particularly important in patients with predisposition to atrial fibrillation. High Emotional reactivity indicates the high sensitivity of the sympathetic branch of the autonomic nervous system, i.e., adrenergic hyperactivity. Strong excitation of the parasympathetic system in stress can facilitate the formation of a wave of atrial fibrillation.

Additional significance to the nature of the symptoms can lend Perseverance. The FCB-TI score for Perseverance was also higher in the sympathetic-type AF group than in the vagal-type AF group, suggesting that emotional stimulation can persist for longer durations in these patients, sustaining excitation of the sympathetic system, which in turn maintains AF. This is consistent with the results of HRV analysis carried out before and during AF episodes (Lombardi et al., 2004).

This association between temperament and type of AF may be detrimental to patients. In many patients, AF episodes are associated with severe anxiety, and patients can experience tension and fear of symptom recurrence in situations or places that are associated with AF (Lane et al., 2009). This fear could be particularly strong in patients with high Emotional reactivity and low Endurance, and may provoke new attacks of AF. This would create a vicious cycle that maintains symptoms, enhances patients' discomfort and lowers quality of life (Ong et al., 2006).

A high Emotional reactivity is described as a risk factor for somatic diseases (Zawadzki, 2001), as well as psychopathological disorders (Strelau, 2002). To this characteristic the role of moderator between experiences and health, both physical and mental, is assigned. A similar role Emotional reactivity can act in patients with sympathetic-type AF. In a situation of high stimulation person with high Emotinal reactivity experiencing an overload, which can lead to the occurrence of symptoms (AF) and increasing the frequency of their prevalence.

By contrast, patients with vagal-type of AF have a stronger temperament for endurance and are more emotionally resistant compared with the patients with the sympathetic-type AF. However, the results of this group do not differ from the average in the population. There is no specific distribution of temperament characteristics. These patients are getting the psychological interpretations of the relationship between stress, temperament, and health. In their case, a major role play other - not yet explained - mechanisms, in which the activity of the autonomic nervous system is also undoubtedly significant. This opens up a new field of research and reflection.

In these patients, AF attacks are not triggered by stress, but occur during rest, relaxation, and sleep. For some patients, this may be particularly worrying because it is difficult to understand symptoms when they do not occur in response to strong emotions, stress, or effort. A restless heart rhythm during relaxation can be incomprehensible to many people, and may induce patients to maintain a high level of activity and stimulation in an attempt to reduce the occurrence of seizures. However, a high level of activity may lead to overload and fatigue, and may also reduce

quality of life (Maryniak et al., 2006).

From a psychological point of view, patients in whom stress is a trigger for AF may benefit from therapy associated with a reduction in emotional tension and relaxation learning. However, for patients with vagal-type AF, such action might be damaging because it may result in intensification of symptoms. These patients need different psychological interventions. The strong presence of the Endurance temperament trait and the low Emotional reactivity may suggest that patients with vagal-type AF will cope with AF well if they receive help understanding the nature and mechanisms of the symptoms, as well as understanding the paradox of symptoms in moments of calm and relaxation.

Understanding the relation between individual patient characteristics and the symptoms of AF may have relevance for therapy and prevention. Frasure-Smith et al. (2012) showed that patients with AF and congestive heart failure, who have high levels of anxiety sensitivity, had better long-term prognosis with rhythm-control therapy than with rate-control therapy.

Limitations

In the present study, the patients themselves reported the situation that was most frequently associated with the occurrence of AF. This may have distorted the results because some AF episodes are not detected by patients (Saveliev & Camm, 2000; Page et al., 1994). Including data from long-term Holter monitoring would be useful to avoid this limitation in future studies. A weekly record should be to maximise the accuracy of data.

Conclusions

The characteristics of temperament were associated with the presence of stress as a trigger for paroxysmal AF. This is particular importance in the case of the sympathetic-type AF. Low potential for stimulating proccesing promotes the occurrence of AF in response to stress. This emphasises the interplay between patient attributes, stress, and disease symptoms, and highlights the relevance of autonomic activity in this interplay.

The knowledge of temperament traits can also be helpful in adjusting proceedings, both medical and psychological, to the individual needs of the patient with AF.

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