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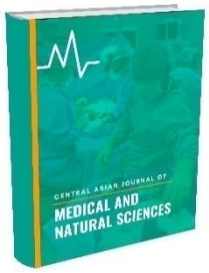

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Relationship of Renal Dysfunction and Atrial Fibrillation in Chronic Heart Disease

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Abstract: THE AIM of the study was to estimate relationship between atrial fibrillation (AF) and renal function, microalbuminuria. PATIENTS AND METHODS. 80 patients with CHF (44-male, 36-female, mean age 62 ±12 years) were evaluated. The cause of CHF in 15 (18,7%) patients was arterial hyperpressure, in 21 (26,2%)–IHD, in 44 (55%) their combination and 36 (45%) patients had myocardial infarction. 39 patients had persistent atrial fibrillation. The speed of glomerular filtration (SGF) was counted by MDRD formulae. Albumins in urine were counted by test-reagent strips. RESULTS. SGF was 65,4±17,6 ml/min/1,73 m2 and in 31 (38,7 %) patients it was<60 ml/min/1,73 m2. In most patients – 54 (67,5 %) of the left ventricular ejection fraction stayed the same (EF>50%). Patients with decreased kidney function had higher diameter of the left ventricular, mitral regurgitation. SGF was lower- 57,6±15,3 against 68,2±17,6 ml/min/1,73 m2, p<0,001 and albumins in urine were higher- 31,4±13,7 against 16,7±9,8 мг/л, p=0,02 in patients with AF, than without AF. CKD and functional class CHF were independently associated with atrial fibrillation. CONCLUSION. So, atrial fibrillation in CHF patients is associated with decrease glomerular filtration rate as well as with elevation of urinary albumin excretion compared to patients with sinus rhythm.

Key words: chronic heart failure, dysfunction of kidney, atrial fibrillation, speed of glomerular filtration, microalbuminuria.

Introduction

Chronic heart failure (CHF) is one of the most significant medical, economic and social problems of the XXI century. According to epidemiological studies, the prevalence of CHF in the USA and Western Europe ranges from 1.9% to 2.5% (Rosamond W. et al., 2007; Neumann T. et al., 2009), and this indicator is steadily increasing.

The problem of cardiorenal relationships in patients with CHF occupies one of the leading places in clinical medicine in recent years. The results of the studies indicate that even the earliest subclinical renal dysfunction is an independent risk factor for cardiovascular complications (CVD) and death, as well as repeated events in patients with CVD [1]. These relationships reflect the concept of cardiorenal relationships [2, 8]. A decrease in glomerular filtration rate (GFR) in patients with CHF of functional class III-IV (FC) and ejection fraction of PV <35% included in the PRIMT–II study was a stronger predictor of mortality than left ventricular LV and FC according to the NYHA classification.

At the same time, in patients with CHF, the prevalence of atrial fibrillation is significantly higher and, according to various data, ranges from 40 to 50% in severe CHF (Go A.S., Hylek K.A. et al., 2006). The Niigata Preventive medicine study showed that the presence of kidney dysfunction in the general population is associated with a higher probability of developing AF, and the presence of AF, on the contrary, is more likely to decrease GFR <60ml/min/1.73 m2. The POSH study [7] showed that atrial fibrillation in patients with CHF is an independent predictor of an increase in serum creatinine concentration during hospitalization. I. Atar et al. of 275 patients on chronic dialysis, AF was diagnosed in 30 (11%). S. Genovesi et al. [6], AF was observed in 132 (27%) of 488 patients receiving hemodialysis treatment.

It has recently been shown that the risk factors and pathogenetic mechanisms of atrial fibrillation and renal dysfunction largely coincide and a large number of studies have been conducted to study the relationship between atrial fibrillation and the functional state of the kidneys [8]. The main risk factors for the development of atrial fibrillation and chronic kidney disease are: obesity, hypertension, type 2 diabetes mellitus, cardiovascular diseases, metabolic syndrome. Common pathogenetic mechanisms in AF and renal dysfunction are: inflammation, oxidative stress, activation of RAAS [9].

The causes of AF are diverse and are highlighted in a number of reviews, including those of patients receiving renal replacement therapy. Most researchers attribute enlargement of the left atrium and changes in the myocardium of the left atrium to factors predisposing to AF. It is known that one of the reasons for the enlargement of the left atrium is diastolic dysfunction of the left ventricle, meanwhile, the basis of CHF in patients with CKD in most cases is diastolic dysfunction. Nevertheless, the interaction of AF and the functional state of the kidneys in CHF has not been studied enough.

The aim of our study was to identify clinical, laboratory and instrumental differences between patients with CHF and a permanent form of AF or with a persistent sinus rhythm (SR), as well as to study the relationship of AF with the functional state of the kidneys.

PATIENTS AND METHODS

80 patients (44 men, 36 women) with CHF aged 40 to 75 (mean age -62 ±12 years) with CHF were examined. The criteria for exclusion from the study were primary pathology of the kidneys, renal vessels and urinary tract, endocrine and oncological pathology. CHF was diagnosed and evaluated according to the National Recommendations of the OSS, RKO and RNMOT for the Diagnosis and Treatment of CHF (fourth revision), 2013 [3]. The characteristics of patients are presented in Table 1.

Table 2. Characteristics of patients with chronic heart failure

Parameters	n (%)
Patients with CHF	80
Men	44 (55%)
Women	36 (45%)
Age	62±12 лет
The cause of CHF:	
Arterial hypertension	15 (18,7%)

Coronary heart disease	21 (26,2%)
Combination of hypertension and coronary heart disease	44 (55%)
Functional class of CHF	
I FC	15 (18,7%)
II FC	39 (48,7%)
III FC	22 (27,5%)
IV FC	4 (5%)
Suffered a myocardial infarction	36 (45%)
Atrial fibrillation	39 (48,7%)

Objectively, the severity of CHF symptoms was assessed using the NYHA classification. To assess the clinical condition of patients, the scale of assessment of the clinical condition of patients (SHOCK) was used.

Depending on the GFR, the patients were divided into 2 groups: the first consisted of 41 patients with CHF without AF, the second - 39 patients with CHF without AF.

All patients underwent echocardiography in M-mode with a 3.5 MHz pulse sensor in the patient's position on the left side. The thickness of the interventricular septum (LVP) and the posterior wall of the left ventricle (LVL) in the diastole was measured, the final diastolic size (CDR), the final systolic size (CSR) of the left ventricle, and the diameter of the left atrium (LP) were determined. The volume of the left ventricle in systole (CSR) and diastole (BDO) was calculated using the Teichholz formula. The ejection fraction (EF) was determined. Systolic function was considered to be preserved at FV greater than 50%.

Creatinine level (Cr) was determined in all patients, and glomerular filtration rate was calculated using the formula MDRD (Modification of Diet in Renal Disease Study equation), chronic kidney disease was diagnosed according to NKF K/DOQI, Guidelines, 2002 [11]. Albumin excretion in urine was determined by Urine-2AC test strips (Langdorp-Belgium). MAU indicators included from 10 to 30 mg/l [4].

The study data were processed using the computer package "STATISTICA 6.0" (Statsoft, USA): the average values of the indicators, the standard deviation, the static significance according to the Mann-Whitney criterion for independent samples, the degree of correlation according to Spearman were determined. The indicators are presented as M±SD. The difference was considered significant at $p < 0.05$.

RESULTS

Among the examined patients, a permanent (>1 year) form of AF was found in 48.7% of patients. 51.3% of patients had sinus rhythm. Table 2 presents the characteristics of the main clinical manifestations in patients with CHF by the presence/absence of AF. GFR was lower in patients with AF than without AF (57.6±15.3 versus 68.2±17.6 ml/min/1.73 m2, respectively, $p<0.001$) (Fig.1.) At the same time, in patients with CHF FC I GFR was 84.3±7.44 ml/min/1.73 m2, with CHF FC II 76.2±16.34 ml/min/1.73 m2, with CHF FC III 62.8±7.3 ml/min/1.73 m2, with CHF FC IV 57.6±5.1 ml/min/1.73 m2.

Table 2. Clinical parameters of CHF patients by presence/absence of AF.

Parameters	CHF patients with AF, n=39	Patients without AF, n=41	P
Age, years	64,2±0,45	54,6±10,7	<0,001
Women/Men	24/15	13/28	P=0,002
Duration of CHF (months)	19,7±5,6	16,7±4,6	
Hemoglobin, g/l	126,4±17,5	132,0±13,2	<0,001
Creatinine (mmol/l)	129,8±10,5	91,9±7,6	<0,001
GARDEN, mmHg.st.	155,0±23,4	154,4±24,5	0,6
DAD, mmhg.st.	91,8±11,3	90,2±13,4	0,7
SHOCK (points)	9,3±0,57	6,5±0,53	<0,001

The results on the SHOCK scale showed that reduced GFR and the presence of atrial fibrillation lead to a deterioration in the clinical condition of patients with CHF and the scores were 4.75.3 ±0.45 in patients with CHF with sinus rhythm and 7.56 ±0.65 in patients with CHF with AF. (Table 3.) The study of symptoms revealed differences in the severity of shortness of breath, weakness, sensation heart failure in patients with sinus rhythm and AF, as well as the symptom, the severity of which differed in these groups, was the anatomical level of edema. The severity of edema was greater in AF than in CP.

Table 3. Clinical assessment scale and six-minute walk test

	Clinical condition assessment scale	Six-minute walk test
CHF without AF associated with renal dysfunction n=21	4,75±0,45	345,2±25,8
CHF with AF associated with renal dysfunction n=18	7,56 ±0,65	236,9 ±56,3

Urinary albumin excretion was lower -16.7 (2.9-37) and 31.4 (17.3-44.7) mg/l, p=0.02 - in patients with sinus rhythm compared with patients with a permanent form of AF.

The left ventricular ejection fraction was 52.7±10.4%. The majority of patients – 51 (68%) had CHF with a preserved ejection fraction. The ejection fraction was smaller in patients with renal dysfunction and AF (53.6±11.7% and 55.8±9.4%, respectively, p=0.03). And these patients also had a larger diameter of the left atrium (38.2±3.2 mm and 50.4±4.1 mm, respectively,

p<0.001) and the final diastolic size of the right ventricle is larger (3.31 (2.93-3.77) cm, respectively, p=0.003).

Discussion

The main causes of CHF in the examined patients were coronary artery disease or hypertension, as well as their combination. The glomerular filtration rate was significantly lower in patients with CHF who had AF. The progression of CHF was accompanied by a deterioration in the clinical condition of patients with SHOCK, which was more pronounced in patients with CHF with renal dysfunction. The presence of renal dysfunction and the severity of CHF (FC CHF), regardless of the gender and age of patients, were associated with AF. There are data in the literature on the relationship between AF and FC CHF. According to the ALPHA study database, the incidence of AF increases with higher values of CHF FC: it is detected in 10% of patients with CHF I FC and 30% of patients with CHF III-IV FC [12]. In our study, individual clinical manifestations of CHF were evaluated and it was shown that AF is associated mainly with the severity of edematous syndrome, which may be due to the fact that with a similar degree of severity of cardiac dysfunction in patients with AF, the severity of renal dysfunction is greater.

The number of studies evaluating the relationship between AF and renal dysfunction in patients with CHF is currently extremely limited and requires close attention to this problem. The relationship between renal dysfunction and AF in CHF may be based on the following mechanisms. On the one hand, activation of the renin-angiotensin-aldosterone system (RAAS) may be accompanied by sodium and water retention, atrial dilation and, consequently, the development of AF [6,13]. On the other hand, regardless of the effect on hemodynamics, activation of RAAS leads to pathological structural and electrophysiological remodeling of the atria, which can be a substrate for the development of AF [13]. In the patients with CHF examined by us, the diameter of the left atrium was larger in the presence of renal dysfunction. An increase in the diameter of the left atrium and changes in the myocardium of the left ventricle are often observed in patients with diastolic dysfunction of the left ventricle, which contributes to the development of atrial fibrillation. It should be taken into account that it is diastolic dysfunction that underlies most cases of CHF in patients with renal dysfunction [5]. The presence of renal dysfunction and an increase in the diameter of the left atrium are independent predictors of death in CHF patients with systolic dysfunction [10], but even in these patients, the severity of diastolic dysfunction is a predictor of an unfavorable outcome [9]. Most of the patients we examined had CHF with a preserved ejection fraction, mitral regurgitation was more often observed in patients with AF associated with renal dysfunction.

Conclusions

1. A feature of clinical symptoms in patients with chronic heart failure and atrial fibrillation, in contrast to patients with sinus rhythm, was a more pronounced edematous syndrome, and the echocardiographic picture was enlarged dimensions of the left atrium and right ventricle.

2. In patients with CHF with CKD, mitral regurgitation is more often observed, the latter, as is known, due to volumetric overload leads to remodeling of the left atrium.

3. Atrial fibrillation in chronic heart failure is accompanied by a more pronounced decrease in glomerular filtration rate and a greater likelihood of developing microalbuminuria than in sinus rhythm.

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