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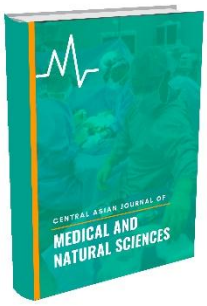

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24-Hour Abp Monitoring Of Blood Pressure In Patients With Chronic Heart Failure And The State Of Kidney Function

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ABSTRACT: The results of the study of the daily profile of blood pressure (BP) in 194 patients with chronic heart failure (CHF), depending on the glomerular filtration rate (GFR), are presented. It was found that the daily monitoring of blood pressure in patients with CHF can significantly increase the frequency of detection of potentially dangerous changes in blood pressure. Target BP is achieved only in 42.9% of patients with CHF and GFR<45.1 ml/min/1.73m^2 and in 18.4% of patients with CHF and GFR>69.8 ml/min/1.73m^2. Episodes of systolic arterial hypotension were detected in 51% of patients with CHF and GFR<45.1 ml/min/1.73 m^2 and 26.5% of patients with CHF and GFR ≥69.8 ml/ min/1.73m^2, episodes of chronic arterial hypotension were diagnosed in 71.4% of patients with CHF and GFR≤45.1 ml/min/1.73 m^2 and 61,2% of patients with CHF and GFR ≥69.8 ml/min/1.73 m2 . The duration of systolic arterial hypotension during the day in patients with CHF correlates with the level of glycemia and the duration of diastolic arterial hypotension-with the age of patients.

Key words: daily monitoring of blood pressure, chronic heart failure, decreased glomerular filtration rate.

Introduction

Chronic heart failure (CHF) in many patients is associated with chronic kidney disease (CKD), while an increase in overall and cardiovascular mortality is observed even with a moderate decrease in kidney function [1]. The risk of cardiovascular events increases especially significantly when the glomerular filtration rate (GFR) is less than 45 ml/min/1.73m^2. Thus, the number of hospitalizations for coronary heart disease(CHD), CHF,

ischemic stroke, and peripheral artery atherosclerosis increases 1.4-times in GFR 45-59 ml/min/1.73 m^2, 2-times in GFR 44-30 ml/min/1.73 m^2, 2.8-times in GFR 29-15 ml/min/1.73 m^2, and 3.4-times in GFR<15 ml/min/1.73 m^2 [2].

Most patients with CKD have systolic arterial hypertension (AH) [3, 4]. The risk of developing nephropathy in patients with hypertension and the rate of progression of kidney damage in CKD are associated with the level of blood pressure (BP), and adequate therapy has a proven nephroprotective effect [5, 6]. In recent years, attention has been drawn to the features of the daily blood pressure profile in CKD [7, 8]. In patients with CKD, changes in the daily blood pressure profile were revealed in the form of an insufficient degree of nocturnal blood pressure reduction [7, 9]. Insufficient nocturnal decrease in blood pressure leads to an increase in the pressure load and contributes to the progression of damage to both the cardiovascular system and the kidneys [5, 10]. Circadian rhythm disorder in patients with CHF is an important predictor of the risk of death and decompensation of CHF. Arterial hypotension in patients with CHF, on the one hand, reflects the insufficiency of cardiac output, on the other - leads to hypoperfusion of vital organs. Five of the seven main classes of drugs for the treatment of CHF lead to hypotension, and this effect is potentiated by the joint administration of drugs of different classes. At the same time, the frequency of arterial hypotension and its clinical significance in patients with chronic heart failure remain insufficiently studied [11].

The aim of the study was to study the daily blood pressure profile in patients with CHF, depending on the functional state of the kidneys.

Materials and methods

97 patients with CHF (54 men and 43 women) were examined; the average age was 56.9±11.0 years. 11 patients were diagnosed with functional class I CHF (FC), 54 patients with FC II, 31 patients with FC III, and 1 patient - IV FC. The causes of CHF were AH - in 51 patients, CHD - in 5, a combination of CHD and AH - in 135, and other heart diseases-in 3. All patients received medical treatment in accordance with the national recommendations of the All-Russian Scientific Society of Cardiology and the Society for the Study of Cardiovascular Insufficiency and for the diagnosis and Treatment of CHF [12].

Systolic dysfunction was diagnosed with a left ventricular ejection fraction (LVEF) of less than 50%. GFR was determined by the MDRD formula, CKD was diagnosed according to NKF K/DOQI, Guidelines, 2002 [13]. The variation series of the GFR was divided into quartiles. A comparative analysis was performed between patients with CHF and GFR=45.1 ml/min/1.73m^2 (lower quartile of GFR) and patients with CHF and GFR=69.8 ml/min/1.73m^2 (upper quartile of GFR). The average values of systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse blood pressure, pressure load indices, and variability were evaluated Blood pressure during the period of wakefulness and sleep, the degree of nocturnal decrease (SNS) in blood pressure, the frequency of detection of arterial hypotension and the index of time of arterial hypotension. The daily blood pressure profile was evaluated according to the the degree of nocturnal decrease in blood pressure SBP and DBP using traditional criteria for determining the two-phase rhythm [14]. Arterial hypotension was diagnosed with office blood pressure of 100/60 mm Hg and less, with 24-hour ABP monitoring for daytime blood pressure of 100/60 mm Hg and less, for night Blood pressure is 85/47 mmHg or less [15]; in addition, the time index of arterial hypotension is taken into account. The results of the study were

statistically processed using computer package Statistica 6,0: determined average values, standard deviation; significance of differences was determined based on the type of distribution of the t-criterion STU-dent or the Mann-Whitney test for independent samples, χ^2. Spearman correlation analysis and linear regression analysis were performed. The indicators are presented in the form of M ± SD. The difference was considered significant at $p < 0.05$.

Results and discussion

The clinical characteristics of patients with CHF and GFR indicators related to the lower and upper quartiles of the GFR variation series are presented in Table 1.

Table 1.

Characteristics of patients with CHF depending on GFR

Indicator	Patients with CHF and GFR<45.1ml/min/1.73m^2 - lower quartile (n =49)	Patients with CHF and GFR≥69.8ml/min/1.73m^2 -upper quartile(n =40)	Statistical indicator
Average age of patients, years	61,0 ± 10,4	51,9 ± 12,0	p <0,001
Women, abs. (%)	22 (51,0)	23 (53,1)	χ^2= 0,04 p = 0,8
Causes of CHF:			
AG	9 (20,4)	18 (42,8)	χ^2 = 5,71 p =0,02
CHD	0	1 (3,3)	χ^2 = 1,01
Combination of CHD and AH	38 (77,6)	27 (55,1)	χ^2=5,53 p =0,02
Other heart diseases	1 (2)	0	χ^2 = 1,01 p =0,3
Diabetes mellitus	14 (28,6)	11 (22,4)	χ^2 = 0,48 p =0,5
Patients who have suffered a myocardial infarction	10 (20,4)	4 (8,2)	χ^2 = 3,0 p =0,08
Medium FC CHF	2,5 ± 0,6	2,0 ± 0,6	p <0,001
LVEF	58,2 ± 7,4	62,2 ± 8,9	p =0,03
Systolic dysfunction (LVEF< 50%)	5 (10,5)	2 (4,7)	χ^2 = 1,39 p =0,24

A decrease in GFR was associated with an increase in the age of patients and a higher FC of CHF. The etiological cause of CHF in patients with GFR=45.1 ml/min/1.73m^2 was more often a combination of CHD and hypertension. Gender differences between patients with chronic heart failure with GFR≤45.1 ml/min/1.73m^2 and GFR≥69.8 ml/min/1.73m^2 was not. There were no differences in the frequency of systolic dysfunction, although the LVEF fraction in the group of patients with CHF and GFR<45.1 ml/min/1.73m^2 was significantly

lower. The lower office SBP and DBP in patients with CHF and GFR<45.1 ml/min/1.73 m^2 was noteworthy. During the 24-hour ABP monitoring lower average daily DBP values were also recorded, while the average daily SBP values only tended to decrease. A more detailed examination revealed that significant differences in the parameters of both SAD and DBP in the group of patients with CHF and low GFR were observed only in the daytime, while there were no differences at night. There was a significant decrease in the degree of nocturnal BP reduction in the group of patients with CHF and GFR<45.1 ml/min/1.73m^2. Despite medical treatment, in the group of patients with CHF and GFR≤45.1 ml/min/1.73 m2, the average daily target BP of less than 130 mm Hg was achieved only in 21 (42.9%) patients, even less often the target BP was achieved in the group of patients with CHF and GFR≥69.8 ml/min/1.73m^2 - only in 9 (18.4%) patients (χ^2=5.8, p=0.02). In 23 (46.9%) patients with CHF and GFR<45.1 ml/min/1.73m^2, the average daily AH time index exceeded 50%. In the group of patients with CHF and GFR≥69.8 ml/min/1.73 m^2, the average daily AH time index exceeded 50%, in 32 (65.3%) patients it was more than 50% (χ^2 = 2.7, p=0.1). The average daily DBP of less than 80 mm Hg was achieved in 27 (55.1%) patients with CHF and GFR≤45.1 ml/min/1.73m^2 versus 11 (22.4%) patients with CHF and GFR≥69.8 ml/min/1.73m^2 (χ^2=9.7, p=0.002). The average daily AH time index exceeded 50% in 14 (28.6%) and 22 (44.9%) patients, respectively, (χ^2=2.2, p=0.1).

Patients with arterial hypotension at the office measurement of blood pressure were not detected in both groups. During the 24-hour ABP monitoring, episodes of systolic arterial hypotension were observed in 25 (51%) patients with CHF and GFR<45.1 ml/min/1.73m^2 and in 13 (26.5%) of patients with CHF and GFR≥69.8 ml/min/1.73 m^2 (χ^2= 5.2; p =0.02). Episodes of diastolic arterial hypotension were detected in 35 (71.4%) patients with CHF with GFR≤45.1 ml/min/1.73m^2 and in 30 (61.2%) patients with CHF and GFR≥69.8 ml/min/1.73 m^2 (χ^2=0.73; p=0.4). Episodes of arterial hypotension were more often observed in the daytime. In the group of patients with CHF and GFR<45.1 ml/min/1.73m2 the time index and the area index of arterial hypotension were higher than in patients with CHF and GFR≥69.8 ml/min/1.73m^2; the differences reached statistical significance in the daytime.

It is noteworthy that there is no correlation between the time index of arterial hypotension and GFR. At the same time, a significant dependence of the time index of arterial hypotension on age, glycemia, and functional class of CHF was revealed. When performing a linear regression analysis, it was found that only the level of glycemia has an independent effect on the duration of systolic arterial hypotension during the day (χ2 = 5.98, p=0.01), and the duration of diastolic arterial hypotension— only age (χ2 = 4.2, p=0.04).

The pathophysiological mechanisms and clinical significance of changes in the daily blood pressure profile remain unclear. The association of violations of the daily blood pressure profile with the age of patients, the presence of CKD, diabetes mellitus, CHD, cerebrovascular pathology and CHF was established [16]. The role of increasing the activity of the sympathetic nervous system and reducing vagal stimulation, reducing sodium excretion [17], reducing physical activity, increasing the use of table salt, and smoking is discussed [18].

Several studies revealed that in contrast to the General population for patients with CHF, the elevation of SBP is a favorable prognostic factor, higher SBP indicates an earlier phase of the disease with higher cardiac output, with other, more commonly used of the recommended therapeutic dose of essential medicines for treating heart failure (angiotensin

converting enzyme inhibitors, β-blockers, diuretics) in patients with normal or elevated blood pressure parameters [20-23]. Studies conducted in recent years have convincingly demonstrated that in CHF there is a U-shaped curve of the risk of death depending on the level of blood pressure [24]. At the same time, a decrease in survival is observed already at SBP less than 120 mmHg. It is assumed that both severe myocardial dysfunction and iatrogenic effects may occur in the genesis of arterial hypotension. Arterial hypotension leads to a decrease in coronary blood flow, myocardial ischemia, and as a result, the occurrence of arrhythmias [25-27]. It is known that most patients with CHF have various cardiac arrhythmias; in 2/3 of patients with the initial stages of CHF and in 1/3 of patients with the final stages of CHF, the outcome of the disease is sudden death, probably due to arrhythmia [12]. Finally, both arterial hypotension and hypertension can lead to damage to other organs: the kidneys, brain, and peripheral vessels.

The lack of decrease in blood pressure at night is negatively affecting the target organs [28, 29], and found that relative wall thickness and left ventricular mass index of the left ventricular myocardium and the levels of atrial and brain natriuretic peptides in the serum increase, even with normal blood pressure in patients with daily the blood pressure profile of a non-dipper [30]. M. Davidson et al. [31] As a result of a three-year retrospective follow-up of 322 patients, a significant decrease in GFR was noted only among patients with a daily non-dipper blood pressure profile. The absence of nocturnal blood pressure reduction in elderly people who do not suffer from CHF, heart defects and do not have left ventricular hypertrophy is associated with a 2,21 fold increase in the relative risk of developing CHF [32]. At the same time, a violation of the circadian rhythm of blood pressure In patients with CHF, it is an important predictor of the risk of death and decompensation of CHF [11].

The results of our study showed a lower blood pressure in patients with CHF and GFR<45.1 ml/min/1.73m^2, with significant differences in both SBP and DBP achieved only in the daytime. Taking into account the more severe functional class of CHF and the decrease in LVEF, it can be assumed that the main significance here was the deterioration of the contractile function of the myocardium, as well as diastolic dysfunction.

It is known that in both CHF and CKD, the tone of the sympathetic nervous system increases [33, 34], which is clinically manifested by tachycardia. In contrast to expectations, in our study, the heart rate (HR) in 24-hour ABP monitoring in patients with CHF and reduced GFR was lower than in patients with CHF and preserved GFR. At the same time, a statistically significant difference was found only in the daytime, while at night the heart rate was the same in both groups. This may be due to a decrease in physical activity in patients with more severe CHF. As expected, patients with CHF with low GFR had an insufficient degree of nocturnal BP reduction.

The prevalence, causes, and clinical significance of episodes of arterial hypotension in patients with CHF remain poorly understood. The results of our study revealed a higher prevalence and severity of arterial hypotension in patients with CHF with a marked decrease in GFR, which may be important for explaining the reduced survival in patients with CHF associated with CKD [35]. The genesis of the increase in the frequency of arterial hypotension in patients with CHF with impaired renal function requires further study. This may be due to a more severe course of CHF and intensive drug therapy. At the same time, we did not find a reliable relationship between the state of filtration function of the kidneys and the time index

of arterial hypertension. Disorders of carbohydrate metabolism and age-related changes in the vascular wall can disrupt the autonomic innervation and the baroreceptor mechanism of blood pressure regulation, exacerbating the resulting disorders of hemodynamics. Further studies are needed to clarify the prognostic value of arterial hypotension in patients with CHF.

Conclusions:

1. Daily monitoring of blood pressure in patients with chronic heart failure can significantly increase the frequency of detection of potentially dangerous changes in blood pressure
2. Episodes of systolic arterial hypotension were detected in 51% of patients with chronic heart failure and glomerular filtration rate of 45.1 ml/min/1.73m^2 and less, and in 26.5% of patients with chronic heart failure and glomerular filtration rate of 69.8 ml/min/1.73m^2 and more, episodes of diastolic arterial hypotension were diagnosed in 71.4% of patients with chronic heart failure and glomerular filtration rate of 45.1 ml/min/1.73m^2 and less and in 61.2% of patients with chronic heart failure and glomerular filtration rate of 69.8 ml/min/1.73m2 or more.
3. The duration of systolic arterial hypotension during the day in patients with chronic heart failure is increased in patients with concomitant diabetes mellitus, and the duration of diastolic arterial hypotension is increased in elderly and senile patients.

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