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Cardiac remodeling hypertensive patients with different forms of thyroid dysfunction

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Abstract

Objective. To analyze the changes in the structural and functional characteristics of the heart, clinical severity of heart failure (HF) and the levels of N-terminal fragment of the brain natriuretic peptide (NT-proBNP) in patients with arterial hypertension (HTN) and various forms of the thyroid dysfunction (TD). **Design and methods.** The total of 101 HTN patients were included in the study: 40 with hypothyroidism; 39 — with hyperthyroidism, 22 — without any TD. Control group consisted of 20 persons without any cardiovascular pathology and TD. Basic structural and functional parameters of the heart, serum levels of NT-proBNP were studied. **Results.** In patients with TD, HF was revealed significantly more often than in the group of AH without TD. There with patients with hypothyroidism had higher, HF functional class compared to the group of hyperthyroidism. In the group of HTN with hypothyroidism left ventricular (LV) hypertrophy and decrease of E/A ratio were observed, whereas patients with HTN and hyperthyroidism were characterized by LV dilatation and by a significant increase of serum NT-proBNP level. **Conclusions.** In HTN patients with hyperthyroidism cardiac remodeling is characterized by the prevalence of LV dilatation, whereas in hypothyroidism LV hypertrophy with LV diastolic dysfunction dominate. Hyperthyroidism is also associated with increased NT-proBNP serum levels.

Key words: arterial hypertension, hypothyroidism, hyperthyroidism, cardiovascular system, heart remodeling, brain natriuretic peptide, heart failure

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Влияние различных вариантов дисфункции щитовидной железы на характер ремоделирования сердца у больных артериальной гипертензией

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Резюме

Цель исследования — провести сравнительный анализ изменений структурно-функциональных характеристик сердца, клинической выраженности сердечной недостаточности (СН) и уровня предшественника мозгового натрийуретического пептида (МНП) (NT-proBNP) у больных артериальной гипертензией (АГ) в сочетании с различными вариантами дисфункции щитовидной железы (ЩЖ). **Материалы и методы.** Обследован 101 пациент: 40 человек с АГ в сочетании с гипотиреозом; 39 — с АГ в сочетании с тиреотоксикозом; 22 — с АГ без дисфункции ЩЖ. Контрольную группу составили 20 человек без сердечно-сосудистой патологии и дисфункции ЩЖ. У всех исследуемых изучались основные структурные и функциональные параметры сердца, клиническая выраженность СН, сывороточные уровни NT-proBNP. **Результаты.** У больных с нарушением функции ЩЖ СН выявлялась чаще по сравнению с группой АГ без дисфункции ЩЖ. При этом пациенты с гипотиреозом характеризовались более высокими стадией и функциональным классом СН по сравнению с группой гипертиреоза. В группе АГ с гипотиреозом регистрировалось увеличение толщины стенок левого желудочка (ЛЖ) в сочетании с уменьшением соотношения E/A по трансмитральному кровотоку, тогда как у пациентов с АГ и гипертиреозом было выявлено увеличение размера полости ЛЖ, а также значительное повышение уровня NT-proBNP в крови. **Заключение.** При АГ в сочетании с гипертиреозом ремоделирование миокарда проявляется преобладанием дилатации ЛЖ, тогда как у больных АГ с гипотиреозом преобладает гипертрофия миокарда ЛЖ в сочетании с его диастолической дисфункцией. Гипертиреоз при этом ассоциируется с повышением уровня N-концевого фрагмента МНП.

Ключевые слова: артериальная гипертензия, гипотиреоз, гипертиреоз, сердечно-сосудистая система, ремоделирование сердца, мозговой натрийуретический пептид, сердечная недостаточность

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Introduction

Thyroid dysfunction (TD) is one of the most common diseases among endocrine pathologies [1,2]. The incidence of clinical hypothyroidism and thyrotoxicosis is 2–4 % in women and 2–3 % in men population and reaches 7–10 % for subclinical forms. In females aged over 50 years the prevalence of thyroid pathology can reach 12 % and more [3–5].

Both deficiency and excess of thyroid hormones negatively affects the activity of all organs and systems [1,3,4]. Cardiovascular manifestations takes the leading place in patients with diseases. Signs of cardiovascular disorders are found in 80 % of patients with hypothyroidism and in 85 % patients with thyrotoxicosis [5]. Deficiency of thyroid hormones contributes to the development of metabolic disorders, which can lead to structural and functional changes of heart and vessels. Hypothyroidism, including its subclinical forms, are recognized as a risk factor for coronary heart disease, which is associated with lipid, coagulation, microcirculatory changes observed in this pathology. The literature data on the influence of hypothyroidism on structural and functional state of the heart are controversial. Some studies report the development of concentric left ventricular (LV) hypertrophy, associated with overweight and with increased blood pressure (BP) [4]. Other researchers, confirming the increased myocardial mass in patients with hypothyroidism, note that LV hypertrophy is reversible with the achievement of euthyroid status, and it can be associated with interstitial myocardial edema [1].

Hyperthyroidism is associated with an increase in sympathetic tone and depression of parasympathetic part of cardiac autonomic innervation [6, 7]. It leads to hemodynamic, metabolic, energy disorders that manifest themselves in the formation of a hyperkinetic type of circulation, a decrease in exercise tolerance, and, in case of severe course of the disease, to the development of thyrotoxic heart — secondary cardiomyopathy manifested by a pronounced structural and functional cardiac abnormalities and by severe heart failure (HF). Most of the researchers revealed LV hypertrophy in patients with thyrotoxicosis [3, 8–10]. Other researchers note that the character of myocardial remodeling in such patients depends on the hyperthyroidism exposition and the degree of its severity. In particular, Osuna states that if at the initial stages thyrotoxic cardiomyopathy has a hypertrophic character, in patients with the advanced stage of the disease dilatation of heart chambers, primarily of the LV, develops [2].

Changes in CVS regulation caused by the thyroid hormones deficiency or excess effect blood pressure (BP) level. Intima-media complex dysfunction as well the autonomic nervous system and renin-angiotensin-aldosterone system activity changes, disturbances of water-electrolyte balance lead to the development of arterial hypertension (AH) in patients with thyroid dysfunction or influence the course AH in case of its onset preceding development of thyroid gland pathology [4, 6].

One of the markers of cardiac dysfunction is the increase of brain natriuretic peptide (BNP) blood level. BNP is a specific protein produced by ventricular cardiomyocytes in response to myocardial stretch. Because of its higher ex vivo stability N-terminal BNP precursor (NT-proBNP) determination is usually used in clinical practice. The literature data on NT-proBNP levels in patients with thyroid pathology are quite contradictory [11–13]. In one study, it has been shown that T4 elevation is associated with an increase of plasma BNP in patients with hyperthyroidism, regardless of the presence of cardiovascular pathology, allowing the assumption of the direct effect of thyroid hormones on BNP synthesis [12].

Thus, thyroid function disturbances should be attributed to the cardiovascular disease risk factors. Despite the fact of numerous studies of the role of various cardiovascular risk markers being carried out currently, a lot of questions on the cardiovascular aspects of thyroid dysfunction has not beenelucidated yet. A comprehensive study of the mechanisms underlying thyroid dysfunction-induced cardiovascular disorders can provide a significant contribution to the increase of the effectiveness of this group of patients treatment.

Objective

To analyze cardiac structural and functional characteristics changes, clinical course of HF and NT-proBNP levels in patients with AH and different forms of thyroid dysfunction.

Material and methods

The study included 101 patients with mild and moderate AH, aged from 39 to 58 years. Among

them: 39 AH patients with thyrotoxicosis (6 men and 33 women, mean age 50.15 ± 1,.11 years); 40 AH patients with hypothyroidism (8 men and 32 women, mean age 52.63 ± 0.58 years); 22 AH patients without thyroid dysfunction (5 men and 17 women, mean age 49.4 ± 1.42 years). The control group consisted of 20 persons without cardiovascular and thyroid pathology (9 men and 11 women, mean age 51.20 ± 0.87 years). All groups were age, sex, severity of AH matched.

AH was diagnosed according to the Russian recommendations (fourth revision, 2010) on diagnostics and treatment of AH [14]. Mean duration of AH did not differ significantly between the groups of patients: 5.47 ± 3.54 years in hyperthyroid group; 4.64 ± 2.89 years in hypothyroid group; 6,13 ± 4,37 years in AH without thyroid dysfunction group. In all patients AH had been diagnosed 2–5 years before the revealing of thyroid dysfunction clinical and/or laboratory signs, which confirms the initially primary character of AH in all patients included to the study.

The diagnoses of hyperthyroidism and hypothyroidism were based on the clinical status and hormonal profile evaluation and made in accordance with the Russian Association of Endocrinologists and the American Thyroid Association criteria [15, 16].

All patients with thyroid dysfunction at the time of inclusion to the study were taking L-thyroxine for hypothyroidism and thiamazole for hyperthyroidism. The duration of thyroid dysfunction varied between 14 to 23 months: mean 18.1 ± 0.6 months in group of hypothyroidism; mean 18.5 ± 0.5 in group of hyperthyroidism. At the time of inclusion in the study, all patients had clinically manifesting thyroid dysfunction requiring therapy correction. Patients with subclinical forms of thyroid dysfunction and with its stable compensation were not included to the study.

At the time of inclusion to the study all patients received antihypertensive therapy. The frequency of antihypertensive drugs classes administration did not differ between the groups. At the time of inclusion, all patients had adequate BP control according to the office measurement data. Mean BP values was not significantly different: 132.1 ± 2.2/79.2 ± 1.4 mm Hg in the group of AH with hyperthyroidism; 130.1 ± 2.4/84.9 ± 2.5 mm Hg in the group of AH with hypothyroidism; 133.4 ± 1.2/83.3 ± 2.3 mm Hg in the group of AH without thyroid dysfunction. Patients with uncontrolled AH were not included in the study.

Before the inclusion to the study all patients signed the informed consent.

The exclusion criteria were: AH diagnosed after the development of thyroid pathology; secondary AH; cerebrovascular diseases (ischemic and hemorrhagic stroke); cardiac ischemia; non-coronary heart diseases, not related to thyroid pathology; hemodynamically significant congenital or valvular heart diseases; diabetes mellitus; alcohol and drug addiction; malignancy; chronic renal failure; chronic hepatic insufficiency; chronic pulmonary insufficiency; inflammatory diseases (acute and exacerbation of chronic); pregnancy.

Structural and functional parameters of the heart were determined by echocardiography (EchoCG) (Philips HD 4000). The size of left atrium (LA), left ventricular (LV) end-diastolic size (EDS), LV end-systolic size (ESS), LV posterior wall (LVPW) thickness, interventricular septum (IVS)thickness, LV ejection fraction (LVEF), right ventricle size (RV) were evaluated. LV diastolic function was assessed by transmitral flow with parameters: isovolumic relaxation time (IVRT), transmitral flow velocity ratio (E/A).

Serum NT-proBNP concentration were determined by single-step solid-phase enzyme immunoassay using NT-proBNP reagent kit (VECTOR BEST, Russia)

Statistical analysis performed with Microsoft Excel and STATISTICA 6 software. All quantitative data are presented in M (mean value) ± m (error of the mean). Nonparametric statistics methods were used. To compare the groups Kruskel-Wallis test was calculated first, then the groups were matched in pairs by means of Mann-Whitney test. Differences reliability in binary parameters was determined by Fisher's exact test. For evaluation of the indices relationships Spearman's correlation coefficient was calculated. Statistically significant differences and correlations were considered at the level of $P<0.05$.

Results

Mean thyroid hormone levels differed significantly between the groups, which is quite natural given the thyroid gland functional state in the groups studied. For example, thyroid stimulating hormone (TSH) averaged 1.94 ± 0.09 μIU/ml in

control group; 0.03 ± 0.01 μIU/ml in the group with AH and hyperthyroidism; 17.40 ± 4.09 μIU/ml in the group with AH and hypothyroidism; 2.00 ± 0.20 μIU/ml in group with AH. Mean level of free T4 in control group was 15.50 ± 0.38 pmol/l; 58.89 ± 13.25 pmol/l in the group with AH and hyperthyroidism; 6.90 ± 1.13 pmol/l in the group with AH and hypothyroidism; 16.90 ± 0.54 pmol/l in the group with AH. There were no differences in thyroid hormones levels between AH patients without thyroid dysfunction and controls.

The distribution of patients from the different groups by stage and by functional class (FC) of HF is presented in Table 1.

All patients from all groups had normal (>50%) LVEF. Therewith in groups of patients with thyroid dysfunction the frequency of HF occurrence was significantly higher compared to the group of AH without thyroid dysfunction. In patients with hyperthyroidism the incidence of stage 1 of HF was significantly higher compared to other groups. Patients with AH and hypothyroidism most commonly had HF of stage 2A. None of the subjects had HF of 2B and 3 stages. As to the functional class of HF, it was found that patients with thyroid dysfunction were equally likely to have FC 2 (as evidenced by the presence of a significant difference with the group with AH without thyroid dysfunction and the lack of reliability between groups with thyroid pathologies). In patients with hypothyroidism, the presence of FC3of HF was significantly higher than in the rest of groups.

Comparative analysis of cardiac structural and functional parameters revealed a significant difference in the majority of values between groups of patients with combination of AH and thyroid dysfunction and a group of AH patients without thyroid pathology and with a control group (Table 2).

In the group of AH patients with hyperthyroidism an increase of LA size in comparison with control group was found. Most pronounced differences between the groups were observed in LVEDS. It was significantly higher in patients with AH and hyperthyroidism compared with other groups. Also in this group a significant increase of LA, RV and a lower LVEF compared with control group were revealed. It is worth noting that in average, none of the parameters did go beyond the normal range, whereas the presence of significant differences in comparison with healthy individuals testifies to myocardial remodeling in this group of patients. Increase of the walls thickness in AH patients with hyperthyroidism should be noted as well. Without going beyond the normal rangein average, it nevertheless differed significantly with the control group value, which, apparently, could be due to the presence of AH in these patients. However, LVPW thickness in this group was significantly lower than in the group of AH without thyroid dysfunction.

Table 1

CHARACTERISTICS OF HEART FAILURE IN PATIENTS OF THE EXAMINED GROUPS

Parameter	AH with hyperthyroid group (n = 39)	AH with hypothyroid group (n = 40)	AH group (n = 22)
HF 0	12.8%P_{AH}	7.5% P_{AH}	50.0%
HF 1	87.2% $P_{AH}P_H$	30.0% P_H	50.0%
HF 2A	12.8% P_H	67.5% $P_{AH}P_H$	0%
FC 1	33.3%	22.5%	40.9%
FC 2	61.5% P_{AH}	50.0% P_{AH}	9.1%
FC 3	5.1% P_H	27.5% $P_{AH}P_H$	0%
Average FC	1.71 ± 0.08 P_{AH}	2.05 ± 0.11 P_{AH}	0.41 ± 0.11

Note: PH — reliability of the difference between groups with thyroid pathology (< 0.05); PAH — reliability of the difference with AH group (< 0.05).

Table 2

CARDIAC STRUCTURAL AND FUNCTIONAL CHARACTERISTICS IN THE EXAMINED GROUPS

Parameter	AH with hyperthyroid group (n = 39)	AH with hypothyroid group (n = 40)	AH group (n = 22)	Control group (n=20)
Aorta, cm	2.97 ± 0.04	3.17 ± 0.05	3.12±0,08	3.06±0,06
LA, cm	3.97 ± 0.09 P_c	4.05 ± 0.08 P_cP_{AH}	3.71±0,08	3.61±0,04
LV EDS, cm	5.35 ± 0.07 $P_cP_{AH}P_c$	4.99 ± 0.07	4.90 ± 0.05	4.82 ± 0.04
LV ESS, cm	3.33 ± 0.08	3.26 ± 0.06	3.28 ± 0.07	3.31 ± 0.06
IVS, cm	0.92 ± 0.02 P_cP_H	1.20 ± 0.04 $P_{AH}P_CP_H$	0.97 ± 0.03P_c	0.82 ± 0.02
LVPW, cm	0.84 ± 0.02 $P_{AH}P_H$	1.11 ± 0.03 P_cP_{AH}	0.95 ± 0.02 P_c	0.80 ± 0.02
LV EF, %	64.66 ± 0,85 P_c	64.94 ± 0.85 P_c	64.93 ± 0.87 P_c	69.80 ± 0.82
RV, cm	2.23 ± 0.05	2.37 ± 0.05 P_K	2.26 ± 0.07	2.15 ± 0.03
E/A	1.23 ± 0 08 P_c	0.95 ± 0.07 P_cP_{AH}	1.30 ± 0.05	1.51 ± 0.02
E, cm/s	0.78 ± 0.04$P_{AH}P_H$	0.54 ± 0.03P_cP_{AH}	0.67 ± 0.03 P_C	0.86 ± 0.02
A, cm/s	0.57 ± 0,01 P_{AH}	0.57 ± 0.02	0.52 ± 0.02 P_C	0.57 ± 0.02
IVRT, mc	90.32 ± 3.00 P_CP_H	109.82 ± 2.19P_CP_{AH}	94.94 ± 1.54 P_C	72.35 ± 0.41
NT-proBNP, pg/ml	393.06 ± 120.51 $P_CP_{AH}P_H$	45.16 ± 6.81 P_CP_{AH}	41.85 ± 4.04 P_C	18.14 ± 1.27

Note: PC — reliability of the difference with control group (< 0.05); P H — reliability of the difference between groups with thyroid pathology (< 0.05); R AH — reliability of the difference with AH group (< 0.05).

In patients with AH combined with hypothyroidism LV hypertrophy was observed. IVS and LVPW mean thicknesses in this group exceeded significantly the ones in all other groups. This fact can be explained by the increase of peripheral vascular resistance and LV pressure and volume overload caused by extracardiac effects of thyroid hormone deficiency: endothelial dysfunction, intima-media complex thickening, impairment of vascular smooth muscle cells relaxation, each of which is known to contributes independently to diastolic BP elevation [4]. On the other hand, increase of ventricular wall thickness in hypothyroidism patients can also be caused by interstitial edema due to accumulation of fluid and mucopolysacharides in tissues, including the heart [9].

Significant differences in LV wall thickness between groups 2 and 3 werealso found. The presence of LV asymmetric hypertrophy in AH patients with hypothyroidism allows to assume more severe course of hypertension, and, therefore, the worse prognosis for patientsfrom this group. The presence of hypothyroidism in AH patents was also associated with larger sizes of LA and RV, reduction of LVEF comparedto group 3 and controls. Although all these parameters were within the normal range, they differed from group 3 and control.

The analysis of LV diastolic function revealed the following: decrease of E/A ratio and an increase of IVRT in all groups of patients with and without thyroid dysfunction compared to the control group, which indicates to the impairment of myocardial relaxation and the development of diastolic dysfunction caused by AH and myocardial hypertrophy as such. However, intergroup comparative analysis revealed that the reduction of LV diastolic function was more pronounced in patients with hypothyroidism. The average values of E, E/A in this group were significantly lower than normal, while the A peak and IVRT exceeded normal range. These parameters differed not only from the control group, but also from the groupsof AH without thyroid dys-

function and of AH with hyperthyroidism, testifying to the fact of hypothyroidism being an independent factor contributing to the progression of diastolic dysfunction.

It was found that in all groups of patients with AH, regardless of the thyroid function, NT-proBNP serum levels were significantly higher than in control. At the same time, this index significantly exceeded upper limit of the normal range only in group of AH with hyperthyroidism. In this group it was significantly higher than in AH and hypothyroidism group (in 8.5 times), than in AH without thyroid dysfunction group (in 9.2 times) and than in control group (in 21.2 times). According to the literature data, it can be associated with an unfavorable prognosis and with the increased risk of cardiovascular complications [11]. Increased NT-pro-BNP synthesis in patients with hyperthyroidism presumably can be caused by two mechanisms. Considering the direct correlation of NT-pro-BNP level with thyroid hormones concentrations and its normalization after returning to euthyroid status [12], the direct influence of thyroid hormones on BNP synthesis can be assumed. Second mechanism — is the development of heart chambers dilatation known to be one of the typical characteristics of thyrotoxic heart. It is known that stretching of cardiomyocytes is the main trigger for BNP synthesis. In this connection, a considerable increase of NT-pro-BNP serum level in AH patients with hyperthyroidism is consistent with the fact that these patients had the most pronounced dilatation of LV as compared to all other groups.

In correlation analysis, it was established that the duration of thyroid dysfunction correlated with the LA size ($r = 0.43$, $P < 0.05$), LV EDS ($r = 0.82$, $P < 0.05$), RV ($r = 0, 43$; $P < 0.05$) in patients with hyperthyroidism, and with IVS ($r = 0.89$, $P < 0.05$), LVPW ($r = 0.59$, $P < 0.05$), IVRT ($r = 0.50$, $P < 0.05$) in patients with hypothyroidism. Also, the following correlations in groups of patients with thyroid dysfunction should be noted: the level of TSH with LV EDS ($r = –0.37$, $P < 0.05$), with IVS ($r = 0.46$, $P < 0.05$), with LVPW ($r = 0.56$, $P < 0.05$), with E ($r = –0.39$, $P <0.05$), with IVRT ($r = 0.52$, $P < 0.05$) and with NT-proBNP ($r = –0.49$, $P < 0.05$); the level of T4 correlated with LV EDS ($r = 0.49$, $P < 0.05$), with IVS ($r = –0.57$, $P < 0.05$), with LVPW ($r = 0.61$, $P <0, 05$), with LVEF ($r = 0.31$, $P < 0.05$), with E/A ($r = 0.47$, $P < 0.05$) and with NT-proBNP ($r = 0.42$, $P < 0.05$).

Discussion

Thyroid hormones exert a significant influence on cardiovascular system function, as their deficiency as well as their excess negatively affect structural and functional state of hart and vessels. Being an important risk factor for the development of such cardiovascular events as stroke, myocardial infarction, AH is one of the most common causes of medical help seeking in Russian Federation. Given the high prevalence of various forms of AH and thyroid dysfunction, investigation of their comorbidity is a question of a great importance. Despite a large number of studies devoted to AH and thyroid gland pathology there are a few works concerning this comorbidity, which present fairly contradictory data. For example, K. Kato et al. [17] demonstrated an increase of LV myocardial mass, increase of IVS and LVPW thickness, increase of LVEF and a significant reduction of LV diastolic function accompanied with high level of NT-proBNP in patients with hyperthyroidism. Other authors did not find any changes of NT-proBNP levels in patients with thyroid dysfunction [11–13]. D. Ascheim reports the concentric hypertrophy of LV in hypothyroidism patients [6] and N. Rodondi associates hypothyroidism with the risk of sudden cardiac death [8]. In the present study, it was found that in AH patients with hypothyroidism cardiac remodeling is characterized by predominance of LV hypertrophy mostly asymmetric. In AH combined with hyperthyroidism, in contrast, dominating feature of cardiac remodeling is LV dilatation prevailing over hypertrophy.

Studies on systolic function in patients with thyroid gland hypofunction showed rather contradictory results. According to some data, hypothyroidism was associated with LV systolic function reduction (assessed by magnetic resonance imaging), which improved after L-thyroxine therapy [16]. In another study, hypothyroidism patients showed systolic and diastolic dysfunction only during the exercises, resulting to exercise intolerance in these individuals [17].

All groups of patients had similar alterations of transmittal blood flow: an increase of IVRT, reduction of E, increase of A and a decrease of E/A ratio

as compared to control. This pattern of changes corresponds to type 1 of diastolic dysfunction, and, in general, is typical for patients with AH. However, when comparing study groups with each other, it was found that in AH patients with hypothyroidism transmittal blood flow parameters differed significantly from those in patients with isolated AH in the direction of the worsening of LV diastolic dysfunction. This may be due to suppression of the gene encoding Ca-ATPase of the sarcoendoplasmic reticulum (SERCA2) caused by thyroid hormone deficiency. Reduction of SERCA2 activity causes a decrease in Ca reuptake during diastole, and, consequently, an impairment of cardiacmyocytes relaxation [18]. This hypothesis is supported by the presence of direct correlation between TSH level and IVRT in AH with hypothyroidism group. On the other hand, significant LV hypertrophy observed in this group of patients may also play a role as an independent factor promoting progressive reduction of LV diastolic function. The growth of cardiac walls thickness is achieved due to an increase the number of myofibrils in cardiomyocytes. It leads to the rate of contraction slowing due to the replacement of the ATPase myosin isoform alpha to beta. Since cardiomyocytes develop a greater strength of contraction, it must be adequately accumulated to create increased pressure in the LV cavity. It requires the strengthening of intercellular and matricellular connections, which can be achieved by the formation of myocardial fibrosis entailing the reduction of myocardial elasticity. As a functional result of these changes we observe slowing down of LV relaxation. Nevertheless, in addition to fibrosis, this process is based on the same thing — slowing down of Ca reuptake by sarcoendoplasmic reticulum [19–21]. Thus, more profound diastolic dysfunction in AH patients with hypothyroidism most likely can be caused by a combination of factors: LV hypertrophy caused by an increase of peripheral vascular resistance and overload of the heart; impairment of myocardial relaxation due to the lack of thyroid hormones direct effects.

Determination of NT-proBNP serum levels revealed a tendency to its increase in all groups of AH patients. Therewith only in the group of AH and hyperthyroidism combination it exceeded significantly upper limit of the normal range. Considering the fact of rather comparable severity of HF in groups studied contrasting the magnitude of NT-proBNP levels intergroup differences, it seems reasonable to revise the reference range for NT-proBNP serum level as a marker of HF for patients with hyperthyroidism.

Conclusions

Thyroid dysfunction adversely affects the course of AH promoting more profound cardiac remodeling and increase of HF severity.

Cardiac remodeling in AH patients with hypothyroidism is characterized predominantly by LV hypertrophy and diastolic dysfunction, whereas in patients with AH combined with hyperthyroidism LV dilatation is a dominating feature of cardiac remodeling.

A significant elevation of serum NT-proBNP to the levels not corresponding to the clinical severity of HF found in AH patients with hyperthyroidism is suggestive for an independent direct influence of thyroid hormones on NT-proBNP synthesis.

Conflict of interest

The authors declare no conflict of interest.

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