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Evaluation of Pro-Inflammatory Cytokines and Adiponectin in Patients with Hypertension and Overweight

Оценка провоспалительных цитокинов и адипонектина у пациентов с артериальной гипертензией и избыточной массой тела

Abstract

Introduction. Currently, hypertension is one of the most common cardiovascular diseases in the world, the main manifestation of which is a steady increase of blood pressure, which has a negative impact on all target organs. Overweight is one of the important risk factors, because it potentiates vascular remodeling and development of left ventricular hypertrophy, which is a strong predictor of cardiovascular disasters and mortality. Chronic inflammation of adipose tissue is currently of particular interest not only for scientists, but also for clinicians. However, it is of particular interest to study the level of adiponectin and pro-inflammatory cytokines in overweight patients with hypertension, which was the purpose of this study.

Purpose. To evaluate the pro-inflammatory cytokines and adiponectin in patients with hypertension and overweight.

Materials and methods. The study was based on the data of patients, who were hospitalized in the therapeutic Department No. 1 of the health department of the stock company "Motor Sich" in Zaporizhzhia, in the period from 2016 to 2018. There were examined 96 individuals, who met the inclusion criteria. They were distributed according to the body mass index: 64 patients with the stage 2 hypertension and overweight, 32 patients with the stage 2 hypertension with normal body weight.

Results and discussion. The serum adiponectin level of overweight patients with hypertension was 3.67 [2.65; 6.51] μg/ml, which was significantly lower in comparison with the level of 7.83 [6.94; 9.77] μg/ml of normal weight hypertension group and 11.4 [9.1; 13.70] μg/ml in healthy individuals. The level of adiponectin was significantly higher in patients with elevated blood pressure of the 1st degree – 5.13 [3.02; 8.62] μg/ml versus 2.93 [2.52; 4.72] μg/ml in the subgroup with the 2nd degree of BP. The ratio TNF-α/adiponectin was significantly higher in patients with the grade 2 of BP, if compared to patients with the grade 1 of BP – 0.81 [0.44; 1.13] vs. 0.40 [0.21; 0.79], respectively. Thus, in overweight hypertension patients, a significant increase of pro-inflammatory cytokines and decrease of adiponectin levels were revealed. The most significant correlations between BMI and ratio IL-1β/ IL-10 (R=+0.67, p=0.001), as well as BMI and ratio TNF-α/adiponectin (R=+0.60, p=0.001) were revealed. Imbalance in the ratio TNF-α/adiponectin is complex, and it depends not only on overweight, but also on the increase of systolic blood pressure.

Keywords: adiponectin, hypertension, cytokines, overweight patients with hypertension.

Резюме

Введение. В настоящее время гипертоническая болезнь – одно из наиболее распространенных сердечно-сосудистых заболеваний в мире, основным проявлением которого является устойчивое повышение артериального давления, что оказывает негативное влияние на все органы-мишени. Избыточный вес является одними из важных факторов риска, поскольку самостоятельно потенцирует ремоделирование сосудов и развитие гипертрофии левого желудочка, которая является сильным предиктором сердечно-сосудистых катастроф и смертности. Хронический воспалительный процесс жировой ткани в настоящее время представляет особый интерес не только для ученых, но и клиницистов. Особый интерес также представляет изучение уровня адипонектина и провоспалительных цитокинов у пациентов с избыточной массой тела при гипертонической болезни.

Цель. Оценить уровень провоспалительных цитокинов и адипонектина у пациентов с гипертонической болезнью и избыточной массой тела.

Материалы и методы. Основу исследования составили данные пациентов, которые находились на стационарном лечении в терапевтическом отделении № 1 медико-санитарной части АО «Мотор Сич» г. Запорожья в период с 2016 по 2018 г. Было обследовано 96 лиц, которые отвечали критериям включения. Они были распределены в зависимости от индекса массы тела: 64 пациента с гипертонической болезнью II стадии и избыточным весом, 32 пациента с гипертонической болезнью II стадии с нормальной массой тела.

Результаты и обсуждение. В сыворотке крови уровень адипонектина пациентов с гипертонической болезнью и избыточной массой тела составил 3,67 [2,65; 6,51] мкг/мл и был достоверно ниже, чем в группе пациентов с гипертонической болезнью с нормальной массой тела – 7,83 [6,94; 9,77] мкг/мл и у здоровых лиц – 11,4 [9,1; 13,70] мкг/мл. Уровень адипонектина был достоверно выше среди пациентов с уровнем повышения АД I степени: 5,13 [3,02; 8,62] мкг/мл против 2,93 [2,52; 4,72] мкг/мл в подгруппе пациентов со II степенью АД. Соотношение ФНО-α/адипонектина было достоверно выше среди пациентов со II степенью АД по сравнению с пациентами с I степенью АД: 0,81 [0,44; 1,13] против 0,40 [0,21; 0,79] соответственно. Таким образом, у пациентов с гипертонической болезнью и избыточной массой тела выявлено достоверное повышение уровня провоспалительных цитокинов и снижение уровня адипонектина, выявлены наиболее значимые корреляции между индексом массы тела и соотношением ИЛ-1β/ИЛ-10 (R=+0,67, P=0,001), а также ИМТ и соотношением ФНО-α/адипонектин (R=+0,60, P=0,001). Дисбаланс в соотношении ФНО-α/адипонектин носит комплексный характер и зависит не только от избыточной массы тела, но и от повышения систолического артериального давления.

Ключевые слова: адипонектин, гипертоническая болезнь, цитокины, избыточная масса тела у пациентов с артериальной гипертензией.

■ INTRODUCTION

Currently, hypertension (HT) is one of the most common cardiovascular diseases (CVD) in the world, the main manifestation of which is a steady increase in blood pressure, which has a negative impact on all target organs. The importance of HT as a medical and social problem is that it serves as a leading risk factor (RF) for the development of acute cerebral circulation disorders, as well as coronary heart disease (CHD), mortality from which occupies a leading position both in Ukraine and around the world [1, 2].

Identification and study of the role of risk factors deserves special attention in patients with HT, with a view to their subsequent correction. Among the known RF, one of the leading places occupies the overweight, which is determined according to the World Health Classification, as an increase in the body mass index 25–29,9 kg/m^2. Overweight is one of the important risk factors, as it potentiates vascular remodeling and the development of left ventricular hypertrophy (LVH), which is a strong predictor of cardiovascular disasters and mortality [3].

Adipose tissue reacts to afferent signals from the central nervous system expressing a number of receptors and producing such adipocytokines as leptin and adiponectin, which allows us to consider it as an endocrine organ. It was found that adipose tissue is a complex endocrine organ that secretes more than 30 different adipokines, the effects of which are realized both locally and remotely, while regulating a wide range of metabolic and immune processes [4].

Adiponectin is a powerful anti-inflammatory factor that, unlike other adipokines, is secreted only by adipocytes and pre-adipocytes. The mechanisms of the pro- and anti-inflammatory effect of adiponectin are not fully understood, but it is reliably established that it inhibits the secretion of pro-inflammatory cytokines such as tumor necrosis factor-α (TNF-α), interleukin-6, etc., that leads to inhibition of the inflammatory process [5].

Chronic inflammation of adipose tissue is currently of particular interest not only for scientists but also clinicians. It is considered as a consequence of overweight, leading to damage to the vascular wall, and is the link between obesity and atherosclerosis. The inflammatory process of adipose tissue is accompanied by disorders of its metabolism, which leads to a shift in the secretion of adipokines, as well as an increase in the blood level of nonspecific markers of inflammation, such as C-reactive protein (CRP) and interleukins (IL). Proinflammatory status of adipose tissue contributes to the development of chronic low-grade inflammatory condition and metabolic disorders. These disorders are associated with an increased risk of cardiovascular and metabolic diseases, and many other pathological conditions [6, 7].

It is known that individuals with normal metabolic status have a balance of pro- and anti-inflammatory adipokines, and this balance is shifted in favor of pro-inflammatory mediators, as adipose tissue expands with the appearance of overweight. However, it is of interest to study the level of adiponectin and proinflammatory cytokines in overweight patients with hypertension, which was the purpose of this study.

■ PURPOSE OF THE STUDY

To evaluate of proinflammatory cytokines and adiponectin among patients with hypertension and overweight.

■ MATERIALS AND METHODS

The study is based on the data of patients who were hospitalized in the therapeutic Department No. 1 of the health department of stock company "Motor Sich" in Zaporizhzhia, in the period from 2016 to 2018. There were examined 96 individuals who met the inclusion criteria. They were distributed according to the body mass index: 64 patients with stage

2 hypertension and overweight, 32 patients with stage 2 hypertension with normal body weight. A group of healthy individuals included 31 volunteers surveyed in the polyclinic Department of the health care unit. All 127 people surveyed were comparable in age and social status.

Criteria for inclusion in the study: male and female patients aged 45 to 65 years; verified 2nd stage of HT with disease duration of more than 3 years.

Exclusion criteria from the study: cardiac arrhythmias by type of permanent form of atrial fibrillation, ventricular extrasystoles more than class 2 by B. Lown; coronary heart disease, acute myocardial infarction, progressive angina; heart failure more than 2nd class of NYHA (New York Heart Association Functional Classification); bronchial asthma; cardiomyopathy, myocarditis; decompensated heart defects; thyroid dysfunction; acute inflammatory or exacerbation of chronic inflammatory diseases; alcohol dependence, drug addiction, the presence of mental illness; chronic renal failure; impaired liver function; patient's refusal to continue to participate in the study.

All patients were thoroughly screened for inclusion/exclusion. Stage 2 hypertension was diagnosed in accordance with the criteria of the ESH (European Society of Hypertension) /ESC (European Society of Cardiology) (2013, 2018). All patients underwent general clinical, instrumental and laboratory examination in order to verify the diagnosis and determine the comorbidity [8, 9].

The distribution of patients into groups was carried out after determining their compliance with the criteria for inclusion/exclusion of the study depending on the body mass index (BMI):

- the first group included 64 patients with stage 2 hypertension and overweight (average age 59.0 [48.0; 63.0] years);
- the second one consisted of 32 patients with stage 2 hypertension with normal body weight (average age 58.0 [53.0; 63.0] years);
- the third group consisted of 31 healthy volunteers (average age 54.0 [49.0; 61.0] years).

Immunoenzyme analysis

Plasma levels of interleukin-1β, interleukin-10 and tumor necrosis factor-α were determined by enzyme immunoassay using standard kits "Il-1β-ELISA-best", "Il-10-ELISA-best" and "TNF-α-ELISA-best" (Vector-best, Russia) according to the attached instructions. The extent value was determined using a semi-automatic flatbed analyzer "SUNRISE TS" (Austria). Determination of the content of interleukin-1β (interleukin-10, TNF-α) in the sample was carried out after interpolation of the actual data on the standard calibration curve. The plasma content of interleukin-1β (interleukin-10, TNF-α) was expressed in PG/ml.

Plasma adiponectin content was determined by enzyme immunoassay using the kit "Human Adiponectin ELISA E09" (Mediagnost, Germany) according to the instructions. The extent value was determined using a semi-automatic flatbed analyzer "SUNRISE TS" (Austria). Determination of the adiponectin content in the test sample was carried out after interpolation of the actual data on the standard calibration curve. Plasma adiponectin content was expressed in μg/ml.

К содержанию

Treatment of patients

Patients of the main group were randomly divided into two subgroups, which took fixed combinations of antihypertensive drugs. Patients of the first group was administered a combination drug of the Equator ("Gedeon Richter", Hungary) in a dose of 1 tablet (amlodipine 5 mg and lisinopril 10 mg) a day, the second sub – Validip (KRKA, Slovenia) in a dose of 1 tablet (amlodipine 5 mg and valsartan 80 mg) per day. Within 2 weeks, the dose adjustment was performed, if necessary. Dose adjustment was not required in 10 (31.3%) patients of the first subgroup and 13 (40.6%) people of the second, the remaining patients had increased doses of Equator (amlodipine 5 mg and lisinopril 20 mg) 1 tablet per day or Valodip (amlodipine 5 mg and valsartan 80 mg) 1 tablet per day, respectively. The target blood pressure is 130/85 mm Hg and it was achieved in 24 (75.0%) patients in the first group and in 26 (81.3%) patients in the second group. All patients were prescribed rosuvastatin (Roxera, KRKA) in a dose of 10 mg per day.

Statistical processing of the results

The obtained data are presented in the form of median and interquartile range Me [Q25; Q75]. The distribution for each studied indicator was analyzed. The results of the study were processed by parametric or nonparametric statistics, depending on the nature of the sample distribution, using specialized computer applications ApacheOpenOffice (version 4.1) and PSPP (version 0.10.2, GNU Project, 1998–2016). When testing statistical hypotheses, the null hypothesis was rejected at a statistical significance level (p) below 0.05. When comparing more than two independent variables, we used variance analysis (One-way ANOVA) followed by a posteriori tests. Equality of variances was tested using the Leuven test. In case of equality of variances in the study groups, the Scheffe criterion was applied, and in the absence of equality of variances, the T2-Tamhein test was resorted to. In the case of data distribution different from the normal one, we used the analogue of the analysis of variance by Kruskal – Wallis method followed by post-hoc analysis using the Dunn criterion.

■ RESULTS AND DISCUSSION

Obtained results and their discussion

The main demographic characteristics of the examined patients are given in table 1.

The number of overweight patients with HT was 64 people (28 men and 36 women). Median BMI in this group was 28.64 [27.75; 28.91] kg/m^2, duration of HT was 5.00 [4.00; 9.00] years. The number of patients with normal weight and HT was 32 people (10 men and 22 women), median BMI in this group was 23.77 [22.65; 24.49] kg/m^2, duration of HT was 5.00 [3.00; 8.00] years. All examined patients had stage 2 hypertension and had comparable values of heart rate (HR), systolic and diastolic blood pressure (SBP and DBP). The number of healthy persons was 31 ones (14 men and 17 women). The BMI in this group was 24.16 [23.31; 24.44] kg/m^2.

The levels of adiponectin and markers of systemic inflammatory response were determined in the examined individuals. The results are presented in table 2.

Table 1
Characteristics of the examined persons (Me [25; 75], n=127)

Variable	Overweight patients with HT (n=64)	Normal weight patients with HT (n=32)	Healthy individuals (n=31)
	1	2	3
Age, years	59,00 [48,00; 63,00]	58,00 [53,00; 63,00]	54,00 [49,00; 61,00]
P-value	p=0,19		
BMI, kg/m^2	28,64 [27,75; 28,91]	23,77 [22,65; 24,49]	24,16 [23,31; 24,44]
P-value	p_{1-2}=0,001	p_{2-3}=1,0	p_{1-3}=0,001
Female	36	22	17
Male	28	10	14
HR, beats per min.	73,00 [64,00; 80,00]	76,00 [64,00; 82,00]	67,00 [65,00; 75,00]
P-value	p=0,06		
SBP, mm Hg	160,00 [150,00; 170,00]	150,00 [145,00; 160,00]	120,00 [110,00; 125,00]
P-value	p_{1-2}=0,22	p_{2-3}=0,001	p_{1-3}=0,001
DBP, mm Hg	90,00 [90,00; 100,00]	90,00 [90,00; 100,00]	80,00 [75,00; 80,00]
P-value	p_{1-2}=1,0	p_{2-3}=0,001	p_{1-3}=0,001
Duration of HT, years	5,00 [4,00; 9,00]	5,00 [3,00; 8,00]	–
P-value	p_{1-2}=0,29		

The level of IL-1β in the group of overweight patients with HT was 4.01 [2.31; 6.63] PG/ml, which was significantly higher by 41.2% than the value of 2.84 [2.10; 3.52] PG/ml in the group of normal body weight patients with HT (p<0.05). In the group of overweight patients with HT, the level of IL-10 was 2.74 [2,14; 3,59] PG/ml, significantly was lower by 19.2% than in the group of HT patients with normal body weight of 3.39 [2,78; 3,94] PG/ml, and below by 43.5% than the value of 4.85 [3,60; 6,70] PG/ml in the group of healthy people (p<0.05).

Table 2
Levels of adiponectin and markers of systemic inflammatory response in the examined individuals (Me [25; 75], n=127)

Variable	Overweight patients with HT (n=64)	Normal weight patients with HT (n=32)	Healthy individuals (n=31)
	1	2	3
IL-1β, PG/ml	4,01 [2,31; 6,63]	2,84 [2,10; 3,52]	0,80 [0,28; 0,91]
P-value	p_{1-2}=0,04	p_{2-3}=0,0001	p_{1-3}=0,0001
IL-10, PG/ml	2,74 [2,14; 3,59]	3,39 [2,78; 3,94]	4,85 [3,60; 6,70]
P-value	p_{1-2}=0,03	p_{2-3}=0,006	p_{1-3}=0,0001
IL-1β/IL-10	1,67 [1,24; 2,16]	0,82 [0,46; 1,13]	0,11 [0,06; 0,16]
P-value	p_{1-2}=0,0002	p_{2-3}=0,0001	p_{1-3}=0,0001
TNF-α, PG/ml	2,16 [1,64; 2,99]	1,32 [1,01; 1,65]	0,37 [0,25; 0,65]
P-value	p_{1-2}=0,0001	p_{2-3}=0,0003	p_{1-3}=0,0001
Adiponectin, μg/ml	3,67 [2,65; 6,51]	7,83 [6,94; 9,77]	11,40 [9,10; 13,70]
P-value	p_{1-2}=0,0001	p_{2-3}=0,03	p_{1-3}=0,0001
TNF-α/Adiponectin	0,66 [0,27; 0,97]	0,15 [0,11; 0,22]	0,03 [0,02; 0,07]
P-value	p_{1-2}=0,0001	p_{2-3}=0,0005	p_{1-3}=0,0001

▼ ▲ К содержанию

The Il-1β/IL-10 ratio in the group of overweight patients with HT was 1.67 [1.24; 2.16], which was significantly higher than 0.82 [0.46; 1.13] in the group of normal weight patients with HT (p<0.05). A comparative analysis of the values of this indicator in the group of patients with normal body weight and healthy individuals showed a significant increase in the ratio of IL-1β/ IL-10 in the group of patients (p<0.05).

The level of TNF-α in the group of overweight patients with HT was 2.16 [1.64; 2.99] PG/ml, and was 63.6% higher than 1.32 [1.01; 1.65] PG/ml in the group of normal weight patients with HT (p<0.05). The serum adiponectin level of overweight patients with HT was 3.67 [2.65; 6.51] μg/ml, and was significantly lower as against the level of 7.83 [6.94; 9.77] μg/ml of normal weight HT group, and against was 11.4 [9.1; 13.70] μg/ml among healthy individuals, (p<0.05). The ratio TNF-α/adiponectin in the group of overweight patients with HT was 0.66 [0.27; 0.97] and significantly exceeded the value of 0.15 [0.11; 0.22] in the group of normal weight patients with HT (p<0.05).

The levels of adiponectin and markers of systemic inflammatory response among patients of the main group were analyzed depending on clinical characteristics. Median age was 59 years, BMI – 28.64 kg/m^2, blood pressure increase was 1 and 2 degrees. Depending on the age of the patients was divided into two groups <59 years (n=34) and >59 years (n=30), median BMI was divided into subgroups <of 28.64 kg/m^2 (n=32) and >of 28.64 kg/m^2 (n=32), according to the degree of increase in blood pressure 2 groups of 32 people were formed. The analysis of adiponectin levels and markers of systemic inflammatory response in patients of the main group depending on clinical characteristics are presented in table 3.

Table 3
The levels of adiponectin and markers of systemic inflammatory response depending on clinical characteristics (Me [25; 75], n=64)

Variable	Age, years		BMI, kg/m^2		Increase BP	
	≤59 (n=34)	>59 (n=30)	≤28,64 (n=32)	>28,64 (n=32)	1 degree (n=32)	2 degree (n=32)
IL-1β, PG/ml	4,02 [2,14; 6,88]	4,01 [2,48; 6,46]	3,69 [2,39; 6,51]	4,64 [2,27; 7,00]	2,69 [1,97; 4,23]	6,09 [3,77; 7,88]
P-value	p=0,92		p=0,68		p=0,0001	
IL-10, PG/ml	2,89 [2,20; 3,87]	2,68 [1,80; 3,48]	2,97 [1,93; 3,82]	2,66 [2,19; 3,43]	2,96 [2,26; 3,73]	2,42 [2,05; 3,46]
P-value	p=0,33		p=0,80		p=0,37	
IL-1β/IL-10	1,64 [0,93; 2,04]	1,68 [1,32; 2,27]	1,68 [1,22; 2,05]	1,56 [1,25; 2,23]	1,35 [0,76; 1,70]	1,92 [1,51; 4,13]
P-value	p=0,85		p=0,91		p=0,0001	
TNF-α, PG/ml	2,53 [1,85; 3,13]	2,07 [1,46; 2,67]	2,02 [1,52; 2,78]	2,54 [1,77; 3,02]	1,98 [1,39; 2,65]	2,62 [2,00; 3,39]
P-value	p=0,49		p=0,17		p=0,01	
Adiponectin, μg/ml	3,87 [2,40; 6,43]	3,60 [2,68; 6,89]	5,68 [2,83; 9,22]	3,28 [2,49; 4,36]	5,13 [3,02; 8,62]	2,93 [2,52; 4,72]
P-value	p=0,80		p=0,01		p=0,02	
TNF-α/ Adiponectin	0,67 [0,37; 1,02]	0,63 [0,23; 0,87]	0,40 [0,21; 0,81]	0,81 [0,47; 1,04]	0,40 [0,21; 0,79]	0,81 [0,44; 1,13]
P-value	p=0,81		p=0,005		p=0,001	

The analysis of subgroups under 59 years of age and over 59 years of age revealed no significant differences among the levels of adiponectin and markers of systemic inflammatory response. When analyzing the adiponectin levels were revealed a significant difference in the level of this indicator between the subgroups with BMI <of 28.64 kg/m^2 and >of 28.64 kg/m^2 was 5,68 [2,83; 9,22] μg/ml vs 3,28 [2,49; 4,36] μg/ml respectively, ($p<0.05$). The ratio TNF-α/Adiponectin among patients subgroups <28.64 kg/m^2 was 0.40 [0,21; 0,81] and was significantly lower vs values of 0.81 [0.47, which; 1.04] among patients with BMI >28.64 kg/m^2, ($p<0.05$). Levels of IL-1β, IL-10, TNF-α and Il-1β/IL-10 did not achieve a significant difference between the subgroups depending on BMI ($p>0.05$).

The level of IL-1β was significantly higher in subgroup 2 of BP degree – 6.09 [3.77; 7.88] PG/ml versus 2.69 [1.97; 4.23] PG/ml in subgroup 1 of BP degree, ($p<0.05$). The ratio of IL-1β/IL-10 was significantly lower in the subgroup of 1 degree of BP versus the value in the subgroup of 2 degree of BP was 1.35 [0.76; 1.70] versus 1.92 [1.51; 4.13] respectively ($p<0.05$). The level of TNF-α among patients of subgroup 1 degree of BP was equal to 1.98 [1.39; 2.65] PG/ml and significantly lower compared to 2.62 [2.00; 3.39] PG/ml among patients with 2 degree of BP, ($p<0.05$). The level of adiponectin was significantly higher among patients with elevated blood pressure of 1 degree was 5.13 [3.02; 8.62] μg/ml versus 2.93 [2.52; 4.72] μg/ml in the subgroup with 2 degree of BP ($p<0.05$). The ratio TNF-α/Adiponectin was significantly higher among patients with grade 2 of BP compared to patients with grade 1 of BP was 0.81 [0.44; 1.13] vs. 0.40 [0.21; 0.79] respectively, ($p<0.05$).

The correlation analysis revealed the most significant reliable direct links between the following indicators: BMI and IL-1β ($R=+0.24$, $p=0.02$); SBP and IL-1β ($R=+0.25$, $p=0.01$); BMI and ratio IL-1β/IL-10 ($R=+0.67$, $p=0.001$); SBP and ratio IL-1β/ IL-10 ($R=+0.35$, $p=0.001$); BMI and TNF-α ($R=+0.49$, $p=0.001$); SBP and TNF-α ($R=+0.25$, $p=0.005$); BMI and ratio TNF-α/adiponectin ($R=+0.60$, $p=0.001$); SBP and ratio TNF-α/adiponectin ($R=+0.31$, $p=0.002$). There were also significant significant feedbacks between the following parameters: BMI and IL-10 ($R=–0.32$, $p=0.001$), BMI and adiponectin ($R=–0.52$, $p=0.001$); SBP and adiponectin ($R=–0.25$, $p=0.02$).

The results of our study revealed a link between adiponectin and the body mass index of patients, and showed that its level is significantly reduced in overweight individuals compared to the control group. This correlates with other studies concerning adiponectin levels in individuals with an elevated body index and obesity. Plasma levels of adiponectin have been shown to decrease with obesity and/or abdominal fat distribution [10].

The group of scientists Y. Arita et al. expression and secretion of adiponectin from adipocytes has been shown to decrease significantly under the influence of TNF-α. This proinflammatory cytokine deserves special attention as it promotes cardiomyocyte apoptosis, metalloproteinase activation, and cardiac remodeling [11].

An experimental study by J.I. Goldhaber et al. showed that the incentive to increase the production of proinflammatory cytokines, including TNF-α, is hemodynamic stress due to increased blood pressure. Increasing TNF-α may occur not only with an increase in body mass index, but also because of hemodynamic stresses, so the problem of inflammatory changes in patients can not be considered in isolation [12].

▼ ▲ К содержанию

The HT is based on complex mechanisms, and it is becoming increasingly clear that adiponectin can make an important contribution to its pathogenesis. Studies have shown that even among normotensive subjects, blood pressure correlates negatively correlated with plasma adiponectin levels, regardless of insulin resistance [13, 14]. Perhaps hypoadiponectinemia contributes to a violation of the regulation of blood pressure by weakening endothelium-dependent vasodilation [15, 16].

Thus, when HT is combined with overweight, the state of adipocytes is characterized as a chronic inflammatory process and may indicate the direct involvement of adipocytes in the pathogenesis of this disease due to the activation of proinflammatory reactions and the formation of adipokine imbalance. Determination of ratio TNF-α/Adiponectin can be used to assess adipokine-cytokine imbalance in HT in combination with overweight, but there is need for further studies are needed to assess the effectiveness of fixed combinations of antihypertensive drugs in this category of patients.

■ CONCLUSIONS

1. Among overweight hypertension patients, a significant increase in proinflammatory cytokines and a decrease in adiponectin levels were revealed, the most significant correlations between BMI and ratio IL-1β/IL-10 (R=+0.67, p=0.001), as well as BMI and ratio TNF-α/Adiponectin (R=+0.60, p=0.001) were revealed.
2. Imbalance in ratio TNF-α/Adiponectin is complex and depends not only on overweight, but also on the increase of systolic blood pressure.

Prospects for further research

Recent studies indicate the important role of cytokines in the pathophysiology of HT and its complications. Further research on ratio TNF-α/adiponectin balance is needed to assess the efficacy of drug correction among patients with both HT and overweight to increase our understanding of overweight syndrome among patients with HT and to help develop strategies for the prevention of cardiovascular complications in this category of individuals.

The authors declare no conflict of interests.

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