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Коробко И.Ю., Нечесова Т.А., Черняк С.В., Горбат Т.В. 154

Гибридный кардиореспираторный скрининг: новый взгляд на нерешенную проблему
Фролов А.В., Козлов И.Д., Сидоренко Г.И., Жилевич Л.А., Воробьев А.П., Мельникова О.П., Гуль Л.М., Маничев И.А., Щербицкий В.Г. 162

Особенности лейкоцитарных индексов у пациентов с артериальной гипертензией и ожирением
Шелест Б.А. 176

Сравнение аллогraftов и механических протезов в лечении инфекционного и протезного эндокардита
Спиридонов С.В., Шкет А.П., Глыбовская Т.В., Одинцов В.О., Щетинко Н.Н., Мозгова Е.А., Островский Ю.П., Омельченко С.Г. 182

Госпитальные результаты протезирования аортального клапана искусственными двустворчатыми клапанами сердца у пациентов с узким фиброзным кольцом
Андралойть И.Е., Шумовец В.В., Гринчук И.И., Шкет А.П., Курганович С.А., Лысенко Е.Р., Усс Н.Л., Островский Ю.П. 199

T323С полиморфный вариант гена EDNRA и артериальная гипертензия у лиц узбекской национальности
Абдуллаева Г.Ж., Нагай А.В., Хамидуллаева Г.А., Абдуллаев А.А. 209

Роль сердечных биомаркеров в прогнозировании синдрома малого сердечного выброса после кардиохирургического вмешательства
Шумовец В.В., Андралойть И.Е., Гринчук И.И., Курганович С.А., Шестакова Л.Г., Валентюкевич А.В., Колядко М.Г., Русских И.И., Островский Ю.П. 219

Практикующему врачу

Гибридная хирургия фибрилляции предсердий: взгляд кардиохирурга
Жигалкович А.С. 230

Обзоры и лекции

Перспективы оценки турбулентности сердечного ритма как предиктора фатальных аритмий у пациентов после острого инфаркта миокарда
Фуштей И.М., Мохамед Феди, Сидь Е.В. 237

Роль инфекции *Chlamydomphila Pneumoniae* в развитии атеросклероза
Сорока Н.Ф., Кудряшов В.А. 244

Оперативные вмешательства на митральном клапане: правосторонняя миниторакотомия или стернотомия?
Обзор литературы
Янушко А.В., Кизюкевич И.Л. 254

Применение лекарственных средств

Показатели вариабельности сердечного ритма у пациентов с пароксизмальной и персистирующей формами фибрилляции предсердий: взаимосвязь с характером течения, сопутствующей патологией и проводимой терапией
Сычев О.С., Шабильянова Л.А. 263

Влияние комбинированной терапии моэксиприлом и дилтиаземом на кардиогемодинамику у женщин с артериальной гипертензией и патологическим течением климакса
Фуштей И.М., Малиновская А.Я., Кулинич И.А. 276

Врачу-практику: место кандесартана (Кандесартан-НАН) в современной терапии артериальной гипертензии
Кравченко Е.В. 286

Материалы конференций

Настоящее и будущее в диагностике и лечении хронической сердечной недостаточности 296

Для авторов 316

Scientific publications. Original researches

Indices vascular wall stiffness and ambulatory blood pressure monitoring in patients with complicated and uncomplicated course of arterial hypertension
Korobko I., Nechesova T., Charniak S., Horbat T.154

Hybrid cardiorespiratory screening: a new look at unsolved problem
Frolov A., Kozlov I., Sidorenko G., Zilevich L., Vorobiev A., Melnikova O., Guel L., Manichev I., Scherbitski V......162

Special features of leukocyte indices in hypertensive patients with obesity
Shelest B......176

Compare allografts and mechanical prostheses in patients with infective and prosthetic endocarditis
Spiridonov S., Shket A., Glybovskaja T., Adzintsou V., Shchatsinka N., Mozgova E., Ostrovsky Y., Amelchanka S.182

Hospital results of aortic valve replacement with mechanical bileaflet prostheses valves in patients with narrow fibrous ring
Andraloits I., Shumavets V., Grinchuk I., Shket A., Kurganovich S., Lysjonok E., Uss N., Ostrovski Y.199

The T323C polymorphism of EDNRA gene and arterial hypertension in Uzbeks
Abdullaeva G., Nagay A., Khamidullaeva G., Abdullaeva A.209

Cardiac biomarker application for stratification of risk of low cardiac output syndrome after open heart surgery
Shumavets V., Andraloits I., Grinchuk I., Kurganovich S., Shestakova L., Valentjuevich A., Kaljadka M., Russkih I., Ostrovski Y......219

To the practitioner

Hybrid surgery for atrial fibrillation: view of cardiac surgeon
Zhyhalkovich A.230

Reviews and lectures

Prospects for assessment of heart rate turbulence as a predictor of fatal arrhythmias in patients after acute myocardial infarction
Fushtey I., Mohamed Fedi, Sid' Ye.237

Role of Chlamydomphila pneumoniae infection in atherosclerosis development
Soroka N., Kudryashov V.244

Mitral valve surgery: right-sided minithoracotomy or median sternotomy? Literature review
Yanushko A., Kiziukevich I......254

Drugs applying

Indicators of heart rate variability in patients with paroxysmal and persistent atrial fibrillation: the relationship with the current character, comorbidity and therapy
Sychov O., Shabilyanova L......263

Effect of combined therapy with moexipril and diltiazem on cardiohemodynamics in women with arterial hypertension and pathological course of menopause
Fushtey I., Malynovska O., Kulinich I.276

Information for practitioner: the place of candesartan (Candesartan-NAN) in modern therapy of arterial hypertension
Kravchenko E......286

Conference proceedings

Development of the diagnosis and treatment of heart failure. The present and the future296

For authors316

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Special features of leukocyte indices in hypertensive patients with obesity

Особенности лейкоцитарных индексов у пациентов
с артериальной гипертензией и ожирением

Abstract

The article presents the results of a survey of 31 patients with arterial hypertension stage II. The average age of the surveyed patients was 62.7 ± 6.4 years. They were used for laboratory and instrumental methods of examination (for verification of the examinees). It has been found that increased blood pressure in hypertension with obesity is characterized by an increase in the number of peripheral blood leukocytes, mainly due to the increase in number of neutrophils and leukocyte index. It was established lymphocyte level decreasing in case of blood pressure increasing, which implies granulocyte quite clear reaction of the body and it can be used as criteria of cardiovascular risk in patients with hypertension and obesity.

Keywords: hypertension, leukocytes, neutrophils, lymphocytes, leukocyte index.

Резюме

В статье представлены результаты обследования 31 пациента с артериальной гипертензией II стадии. Средний возраст обследованных составлял $62,7 \pm 6,4$ года. Были использованы лабораторные и инструментальные методы обследования (для верификации обследованных пациентов). При этом было установлено, что повышение артериального давления при гипертонической болезни с ожирением характеризуется увеличением количества лейкоцитов периферической крови, главным образом за счет нейтрофилов, и повышением ряда лейкоцитарных индексов. При повышении артериального давления отмечалось снижение уровня лимфоцитов, что предполагает достаточно четкую гранулоцитарную реакцию организма, и это можно использовать в качестве критериев кардиоваскулярного риска у пациентов с артериальной гипертензией и ожирением.

Ключевые слова: артериальная гипертензия, лейкоциты, нейтрофилы, лимфоциты, лейкоцитарные индексы.

Arterial hypertension (AH) is one of the major risk factors for cardiovascular disease. Despite the considerable amount of works on the theme of mechanisms for increasing of blood pressure (BP), there is still the problem

finally not resolved. The focus of this is on periods of hospitalization during exacerbations.

In recent years it suggests, that the blood pressure is a physical factor in the regulation of disturbed metabolism in vivo, and at the same time part of the biological response of inflammation, destined to preserve the "purity" of the intercellular environment of multicellular organisms. There is no consensus on whether the formation of hypertension is result of frequent repetition of the stress response syndrome or a consequence of violations of biological function of endoecology [1]. Index ratios (IR) of peripheral blood leukocytes, that characterizing the state of cellular immunity, are also risk factor of stratification of myocardial ischemia [2].

Some researchers suggest a role of inflammation in the development and progression of hypertension, the possibility of using their elements as the treatment goals are considered. Inflammatory markers (C-reactive protein, tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), etc.) are increased in patients with increased BP, and also associated with a poor prognosis. At the same time, the results of population studies demonstrate the role of these parameters in the event of increase in blood pressure in the future. The number of white blood cells is a marker of systemic inflammation. However, the data about their association with the progression of hypertension is controversial [1]. Therefore, the study of number of white blood cells and their indices is important not only from the theoretical, but also from a practical point of view. Perhaps, it will determine pathogenetic mechanisms of high blood pressure development, and at the same time to identify possible ways to correct it.

■ THE AIM OF THE STUDY

To investigate the number of white blood cells of peripheral blood and indicators of leukocyte indices in hypertensive patients during their hospitalization.

■ MATERIAL AND METHODS

The study included 31 patients with essential hypertension stage II. The average age of the patients was 62.7 ± 6.4 years (from 45 to 74 years). Majority (83.87%) of the patients were with average risk score, and the rest – with high risk score. There were 14 males and 17 women in the study. The average systolic blood pressure (SBP) was $(166.2 \pm 5.6$ mm Hg) in the examined patients and average diastolic blood pressure (DBP) 97.3 ± 2.6 mm Hg. Heart rate (HR) was equal to 86.7 ± 2.4 beats per 1 min. Exclusion criteria were the factors that contributed to the influence on the number of neutrophils (infectious and inflammatory diseases, tumors, the use of steroid hormones, kidney failure, acute coronary syndrome, heart failure). The study also included 20 apparently healthy individuals without symptoms of hypertension and obesity as the control group (mean age was – 52.4 years, from 40 to 59 years; males – 12, females – 8, HR – 79.1 ± 3.7).

The diagnosis was verified by using laboratory-instrumental methods, accordingly to recommendations of the European Society of Cardiology (2012–2013). The study was conducted on the ethical principles of scientific research (Helsinki Declaration) and the recommendations of an independent clinical practice. All participants signed an informed agreement. Elec-

trocadiography in 12 standard leads in the supine position after 5 minutes of rest; transthoracic echocardiography (apparatus "Philips HD11XE" (US) by generally accepted method of pulse-echo method with ultrasound frequency of 7.5 MHz) are applied from instrumental methods.

Differential white blood cell count is done as a result of the generally accepted clinical studies. The absolute number of leukocytes and their subpopulations were specified. Ratio index (RI) of leukocyte populations was calculated, it is represented as the quotient of the relative (percentage) content of a cell population in the percentage to other correlated populations: neutrophils and lymphocytes (N/A), neutrophils and monocytes (N/M), lymphocytes and monocytes (L/M) [3].

Statistical processing is performed by using of Statistica 6.0 and Microsoft Excel. Since the distribution of the amounts in all the compared groups was close to normal, we used parametric methods. 0.05 is selected as the critical level of significance value *p*. Statistical hypothesis about absence of difference between the two treatment groups was tested with Student's *t* test (for dependent or independent samples).

In the selective analysis, qualitative and quantitative indicators were assessed by using the absolute and relative (percentage) frequencies. The central pattern and variability of quantitative indicators were calculated with help of the arithmetic mean (*M*) and standard deviation (*SD*), results are presented in the form of expression: $M \pm SD$.

■ RESULTS AND DISCUSSION

The increased number of leukocytes was in patients with hypertension at admission to inpatient treatment (6.78 ± 0.49 , $p < 0.05$) compared with the control group – 5.67 ± 0.34 (Table). This disproportion reflected a violation of interaction between affector and effector links of immune response in hypertension. There were also increased number of neutrophils (64.72 ± 3.27 and 58.82 ± 2.36 , $p < 0.05$, respectively).

Monocytes were also increased, but their changes were unreliable. The lymphocytes, in turn, decreased from 34.26 ± 3.15 (control group) to 28.42 ± 2.53 (surveyed, $p < 0.05$), that characterizes the value of the ratio of components microphage-macrophage immune defense system. Changing the number of the white blood cells lead to the disintegration of nonspecific and specific mechanisms of the immune system.

The destabilization of atheromatous plaques is associated with the predominance of cell infiltrate macrophages of the fibrous cover of lymphocytes, the presence of eosinophilic granulocytes, disorganization and necrosis foci of fibrous connective tissue cover [1], apparently, it defines the relationship of complications of the disease from hypertension mediated by changes in leukocyte features [4, 5].

Significant differences also pointed on the differentiated mechanisms of hypertension in patients with hypertension and without it, that depend on the quantitative balance of cells that are involved in the reactionsof hypersensitivity of immediate and delayed types. The destabilization of atheromatous plaques associated with the predominance of the fibrous macrophages cover on lymphocytes in cell infiltrate,with the presence of eosinophilic granulocytes, disorganization and foci of necrosis in the connective tissue of the fibrous cover [1]. And these processes, apparently, determines the

Indicators leukocytes' formula in the surveyed

Indicators	Control group	Experimental group
Leukocytes (10 ⁹ /l)	5.67±0.34	6.78±0.49*
Neutrophils, %	58.82±2.36	64.72±3.27*
Monocytes, %	5.3±0.9	6.7±1.1
Lymphocytes, %	34.26±3.15	28.42±2.53*

Note: * – significant differences with the control group, p<0.05.

dependence of complications of the disease on hypertension mediated by changes in leukocyte formula [4, 5].

During hospitalization, when there was an increased blood pressure, there were noted a number of changes in leukocyte indices.

This was accompanied by an increase of the index N/L from 1.72 to 2.28, due to the increase of neutrophils (from 58.82±2.36 to 64.72±3.27) and decrease in lymphocytes (from 34.26±3.15 to 28.42±2.53)

Index L/M decreased from 6.46 to 4.24 by reducing lymphocyte (from 34.26±3.15 to 28.42±2.53) and increasing the level of monocytes (from 5.3±0.9 to 6.7±1.1). The index N/M changed less (from 11.1 to 9.66), as it was happening to them unidirectional changes: neutrophils increased with 58.82±2.36 to 64.72±3.27 and monocytes rose.

Changes in the number of the white blood cells lead to the disintegration of nonspecific and specific mechanisms of the immune system. The affinity of the endothelium to different types of migratory cells, interaction between b2-integrins neutrophils and b1-Integrin monocytes with Ig-like proteins of endothelial cells, probably, determine not only the existing differences in the immune system, but also prognostic significance of individual leukocyte populations in AH, when nonsurvival predictor is the relative number of lymphocytes in the peripheral blood of less than 26%, and in the absence of AH leukocyte count below 6 x 10⁹/l [6].

In the development of hypertension is attached importance to the value of an imbalance between the different parts of the brain, enhancing and inhibiting the central sympathetic activity. An initial regulatory shifts in the pressor systems in AH genesis is the activation of the RAAS, hypersympathicotonia, changes in renal volume mechanism of regulation of blood pressure and increased activity of pituitary-adrenal system. It is believed, that the basis of hypertension is an adaptive reconstruction of resistance vessels with endothelial dysfunction and overactivity on tissue level of renin-angiotensin system (RAS), increased production of vasopressin, endothelin-1, reduction of kinins and nitric oxide synthesis by vascular endothelium [7].

Implementation of regulatory effects on the level of cells, which are involved in the immune response, is monitored by adrenergic agents due enhance of specific functions of immune cells. The sympathetic and parasympathetic nervous system are the efferent pathways, through which the central influence on the effector organs of immunocompetent system is realized. Evolutionary development of the immune and endocrine systems is synchronous and interdependent, the endocrine system is under the regulatory control of the hypothalamus, which implements the impact on the

various links of immunogenesis through hormones of pituitary and peripheral endocrine glands.

The chronic adrenocorticotrophin excess inhibits the biosynthesis of deoxyribonucleic and ribonucleic acids and proteins in the lymphoid organs, which results in the involution of the thymus, spleen and lymph nodes reduction. Large doses of exogenous corticosteroids cause inhibition of the humoral immune response, small it can stimulate. One of the possible mechanisms of the adrenocorticotrophin and glucocorticoids effect on immune cells is their ability to alter the exchange of cyclic nucleotides [8]. These data are comparable with the results of several multicenter trials on leukocytes, especially granulocytes, with poor prognosis of ischemic heart disease, particularly myocardial infarction [9].

Increasing the number of leukocytes and neutrophils, possibly indicating inflammatory activity. In experimental studies have been shown that, myocardial proteins are formed in the blood during myocardial ischemia and thus B- lymphocytes are activated. This also contributes to stimulate nonspecific resistance factors and T-cells with increased production of pro-inflammatory interleukins (interleukin-1 β , tumor necrosis factor- α , etc.) [10].

One of the major cellular immune response a function of phagocytic leukocytes, as well as chemokinetic and chemotactic response of polymorphonuclear leukocytes is associated with the operation of the main messengers' cascades.

Proinflammatory cytokines and their receptors, various types of white blood cells are involved in the development of chronic immune inflammation, and, along with the above changes in hypertension, increase in the LII is, probably, a reflection of systemic inflammation in hypertension that violates the physiological function of the affected vessels [11].

■ CONCLUSIONS

1. Increased blood pressure in hypertension is characterized by an increase in the number of peripheral blood leukocytes, mainly due to the increase of neutrophils and number of leukocyte indices.
2. An increasing in blood pressure is associated with decrease of lymphocyte, which implies quite clear granulocyte response.

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