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Research Article

Relationship of Oxidative Stress and Paradoxic Vasaconstrictions of Cavernous Arteries

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Introduction

Oxidative stress is one of the most common pathological processes, the essence of which is an imbalance in the state of the pro- and antioxidant systems of the blood, organs and tissues. This indicates the need for its direct pathogenetic correction, which can be carried out by means of specific and non-specific antioxidant therapy.

Oxidative stress (OS) is a state in which the amount of free radicals generated in the body significantly exceeds the activity of endogenous antioxidant systems that ensure their elimination [1,2].The imbalance between the synthesis and elimination of reactive oxygen forms, affects the homeostasis of cellular oxidative stress, plays an important role in the development of a number of cardiovascular diseases (CVD) in the pathogenesis, including arterial hypertension, hypercholesterolemia, atherosclerosis, diabetes mellitus and heart failure [3-5].

Reactive oxygen species (ROS) are initially normal components of cellular metabolism and perform essential regulatory and metabolic functions in the body. Free radical reactions are necessary for the formation of many vital enzymes, as well as for the normal function of the immune system and its components. Sharp fluctuations in their concentration in cells and tissues can cause many pathological conditions in the body.

The formation of OS, due to increased formation of ROS, especially superoxide anion (O-2) and insufficient mechanisms of antioxidant protection indicates the development of functional and structural disorders of the cardiovascular system. The main characteristic of CVD disorder in the vascular wall is endothelial dysfunction. In vascular cells, a superoxide anion is formed from ROS, which is inactivated by superoxide dismutase (SOD). Endothelial dysfunction is caused not by a decrease in nitric oxide (NO) production, but by excessive O-2 formation, which leads to oxidative inactivation of NO and a decrease in its bioavailability.

In addition, O-2, directly or through the product of its interaction with NO (peroxynitrite), is capable of initiating peroxide damage to the cellular and matrix elements of the vessel wall, leading to disruption of the interaction of the endothelium with cellular elements and blood lipoproteins.

These data indicate that the production of superoxide radicals and other forms of oxygen, uncontrolled by physiological antioxidant enzymes, can be considered as a potential source of vascular dysfunctions, a frequent manifestation of which is endothelial dysfunction.It has been established that both stable high and periodically increased glucose levels induce the development of OS, which, in turn, stimulates apoptosis of endotheliocytes [6].

Direct determination of the level of oxidants under in vivo conditions is practically impossible, since these are extremely reactive and, therefore, short-lived compounds. Ideal OS markers are oxidation products of lipids, carbohydrates, proteins, and nucleic acids, whose lifespan ranges from several hours to several weeks.8-iso-PgF2a (8-isoprostane) is considered to be one of the most specific biological markers that allow one to assess the level of free radical production with a sufficient degree of accuracy, reliability and reproduction of research results.

8-isoprostane is a metabolic product in the reactions of peroxidation of arachidonic acid, isomeric prostaglandin F2 and its amount is directly proportional to the level of formed free radicals [7].OS is one of the links in the formation of pathogenetic changes in the body [8]. An increase in OS and a decrease in antioxidant

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protection lead to mitochondrial DNA damage and depletion of adenosine triphosphate [9]. Today, the role of oxidative stress in the development of endothelial dysfunction has been proven [10].

Molecules formed by oxidation can serve as biomarkers. Their analysis is used to quantify oxidative stress in humans.Biomarkers of mitochondrial dysfunction and oxidative stress are:-8-isoprostane, malonic dialdehyde; O-tyrosine, 3-chlorothyrosine, 3-nitrotyrosine; protein oxidation products (AOPP);8-hydroxyguanosine (8-OHG); 8-hydroxy-2'-deoxyguanosine (8-OHdG); cellular mtDNA (its number and the presence of mutated variants with deletions); endogenous antioxidants (glutathione, cysteine, uric acid, ubiquinol) [11].

Comprehensive assessment of OS, expensive research, infrequent use and relatively long-term implementation, makes this research method limited. It should be noted that not every medical institution can allow the use of the OS assessment research method. The need to find a method for evaluating OS that differs in prostate availability has become relevant at the present time.

In connection with the above, it is of interest to use, as an estimate and a potential regulator of the balance between the synthesis and elimination of ROS, infrared radiation of the far range (IRR FR), which includes electromagnetic oscillations with wavelengths from 1 to 10 mm [12]. One of the main properties of IRR FR is the dependence of the results of exposure on the phase of biological development and on the initial state of the object: the IRR FR practically does not affect the normal functioning of a healthy organism [12-14], and in the event of a pathology, it can regulate its functioning within the limits inherent in this biological kind [15,16].

ROS have a molecular spectrum of radiation and absorption of IRR FR (wavelength 10-2-10-4 m; frequency 1011-1013 Hz) [17]. It was found that the reactivity of molecules excited by an IRR FR quantum will be an order of magnitude higher than when excited by an extremely high frequency electromagnetic radiation quantum [18].

Purpose of research

To assess OS and the relationship with paradoxical vasoconstriction of the cavernous arteries.

Materials and Methods

17 men with CVD and cardiovascular risk factors aged 35 to 65 years (mean age 51.3 ± 1.33 years) were examined in a hospital. The control group consisted of 7 men without CVD and risk factors. Blood for biochemical, enzyme-linked immunosorbent assay was taken in the morning on an empty stomach, the next day after the patient was admitted to the hospital, 12 hours after eating. Blood sampling was performed from the cubital vein. The criteria for excluding patients from the study were concomitant inflammatory, endocrine and other diseases that could affect the activity of oxidative processes. Overweight was assessed using the body mass index (Quetelet index), which is defined as the ratio of body weight (kg) to the square of height (m).

According to modern data, 8-isoprostane (8-PI) is considered to be one of the most specific markers that allow, with a sufficient degree of accuracy, reliability and reproducibility of research results, to assess the level of production of free radicals in the body in a wide variety of pathologies. It is a metabolic product in the reactions of peroxidation of arachidonic acid, isomeric to prostaglandin F2α (PGF 2α). It belongs to the family of eicosanoids, the formation of which occurs during non-enzymatic (free radical) oxidation of phospholipids of cell membranes [9,10]. Its content in blood serum was determined by the enzyme immunoassay using the 8isoprostane ELISA kit from USBiological (USA). The data obtained were expressed in pg/ml.

All men underwent a comprehensive examination, which included the collection of a general medical and sexological history, a general examination, a study of hormonal status, lipid spectrum and blood glucose. All patients underwent a questionnaire survey the International Index of Erectile Function (IIEF-5).In addition, all men underwent a study of the endothelial function of the cavernous arteries, using the method of ultrasound examination of changes in diameter after exposure to narrow-spectrum (far range) IR emitters.

The Percentage Increase in the Diameter of the Cavernous Arteries (PIDCA) was calculated by the formula:

Formula 1.

PIDCA = 100% x (D 2 –D 1) \D1.

Where D1 is the average diameter of both cavernous arteries before irradiation with an IR emitter.

D2 - the average diameter of both cavernous arteries after irradiation.

The threshold value of PIDCA for identification of arteriogenic ED from other forms of ED was 30%. PIDCA <0% was regarded as paradoxical vasoconstriction.

Results and Discussion

The content of 8-isoprostane and the endothelial function of the cavernous arteries in the examined men of 2 groups are presented in Table 1.

As you can see from the Table 1, the patients of the main group showed an increase in the content of 8-isoprostane in the blood serum by 14.1 times as compared with the control group. PIDCA characterizing endothelial function was within the normal range in men of the control group. In patients of the main group, endothelial

dysfunction was revealed, and in 82.3% (n=14) cases, paradoxical vasoconstriction of the cavernous arteries was recorded (PIDCA <0%). Only in 3 patients (17.6%) the endothelial function of the cavernous arteries was recorded as positive. However, these indicators were below normal, which indicated the presence of endothelial dysfunction.

Table 1: Indicators of 8-isoprostate and PIDCA in the examined patients.

Indicator	Control group (n = 7)	Main group (n = 17)
8-isoprostate (pg/ml)	1,43 +- 0,16	20,18 +- 2,85*
PIDCA (%)	37,57+- 5,91	-10,35+- 11,1*

Note: * Significant differences compared with the control group P <0,05.

Correlation analysis between the OS biomarker (8-isoprostane) and paradoxical vasoconstriction of the cavernous arteries in patients with CVD and cardiovascular risk factors showed a negative relationship (r = -0.365; p = 0.043).

Of the surveyed men in the main group, 23.5% were overweight; 76.4% were obese. Type II diabetes mellitus affected 5 (29.4%) men; hypercholesterolemia/dyslipidemia was detected in 94.1% (16) patients; active smokers were 7 (41.2%) patients. When analyzing the IIEF-5 questionnaires of the main group, it was found that the severity of ED was as follows: mild in 5 (29.4%) men, moderate in 10 (58.8%) patients, and severe in 2 (11.8%).

Thus, the data obtained indicate an increase in the activity of 8-IP in the blood serum, which is interpreted as the formation of oxidative stress in CVD and cardiovascular risk factors (obesity, smoking). These indicators correlate with literature data [19-21].

The study of the 8-IP level is the gold standard for determining the OS activity in persons with CVD, as well as in patients with diabetes mellitus, obesity, hypercholesterolemia, and smokers [22].OS forms the development of endothelial dysfunction, the manifestation of which can be a predictor of dangerous vascular disease, and, therefore, can be used as a screening assessment for men after 35 years.

The manifestation of endothelial dysfunction can be both disturbances in the normal blood flow in the penis (decrease or disappearance of spontaneous and adequate erections), and disturbances in the coronary circulation system. Violation of blood flow can manifest itself as erectile dysfunction, and as atherosclerotic coronary artery disease. Erectile dysfunction is a manifestation of endothelial dysfunction without intermediate stages, while atherosclerosis of the coronary arteries most often develops asymptomatically for a long time and manifests as acute coronary syndrome and ischemic heart disease.

The OS, being a systemic process, first of all subjects the vascular endothelium to functional changes, spreading from the "periphery to the center", that is, from the capillaries to the large main or organ vessels.

The mechanism of paradoxical vasoconstriction of the cavernous arteries can be explained as follows. Under the influence of IRR FR, with a frequency corresponding to the molecular spectra of emission and absorption of NO and ROS, phagocytes (monocytes) of blood and endotheliocytes are activated. This leads to the release of NO and ROS, which increases the oxidative stress of the endothelium. In addition, excess NO can bind with superoxide radicals to form the strongest oxidizing agent, peroxynitrite. This leads to endothelial dysfunction, ATP depletion, and increased production of the vasoconstrictor endothelin 1.

Conclusion

Paradoxical vasoconstriction of the cavernous arteries is a manifestation of systemic oxidative stress at the level of regional circulation.The use of long-range infrared radiation in the diagnosis of endothelial dysfunction of the cavernous arteries can also be used to determine the severity of oxidative stress. The use of IRR FR in diagnostics of the system OS has unconditional advantages - these are non-invasiveness, simplicity and speed of execution, the possibility of repeated use, and most importantly, it is economically uncomplicated and beneficial.

References

1. Elchaninova SA, Galaktionova LP, Tolmacheva NV, B Ia Varshavskiĭ (2000) Activity of intracellular antioxidant enzymes in hypertensive patients. Ter Arkh 72(4): 51-53.
2. Kovaleva, ON, AN Belovol, MV Zaika (2005) The role of oxidative stress in cardiovascular pathology. Journ AMS of Ukraine 11(4): 660-670.
3. Mc Cord JM (2000) The evolution of free radicals and oxidative stress. Am J Med 108(8): 652-659.
4. Cai H, Harrison DG (2000) Endothelial dysfunction in cardiovascular diseases: the role of oxidant stress. Circ Res 87(10): 840-844.
5. Sharma A, Bernatchez PN, Haan JB (2012) Targeting endothelial dysfunction in vascular complications associated with diabetes. Int J Vasc Med ID 2012: 750126.
6. Ceriello A (2005) Basic evidence behind postprandial hyperglycaemia. Diabetes and Stoffwechsel 1: 27.
7. Montuschi, P, PJ Barnes, L Jackson Roberts (2004) Isoprostanes: markers and mediators of oxidative stress. The FASEB Journal 18(15): 1791-1800.
8. Xu XJ, Gauthier M-S, Hess DT, Rudy J Valentine, Neil B Ruderman, et al. (2012) Insulin sensitive and resistant obesity in humans: AMPK activity, oxidative stress, and depot-specific changes in gene expression in adipose tissue. J Lipid Res 53(4):792-801.
9. Goossens GH (2008) The role of adipose tissue dysfunction in the pathogenesis of obesity-related insulin resistance. Physiol Behav 94(2): 206-218.
10. Wenceslau CF, McCarthy CG, Szasz T, Styliani Goulopoulou, R. Clinton Webb, et al. (2014) Mitochondrial damage-associated molecular patterns and vascular function. Eur Heart J 35(18): 1172-1177.

11. Odinokov D, Rzheshevsky A (2017) SENS-diagnostics. Biomarkers of Mitochondrial Dysfunction and Oxidative Stress (Review).

12. Betsky OV, Golant MB, Devyatkov ND (1988) Millimeter waves in biology. M Knowledge 64 pp.

13. Golant MB (1989) On the problem of the resonant effect of coherent electromagnetic radiation of the millimeter range on living organisms. Biophysics 2: 339-348.

14. Golant MB (1989) Resonant action of coherent electromagnetic radiation of the millimeter wave range on living organisms. Biophysics 6: 1004-1014

15. Golant MB (1985) Biological and physical factors determining the influence of monochromatic electromagnetic radiation of the millimeter range of low power on vital activity. Application of low-intensity millimeter radiation in biology and medicine pp. 21-36.

16. Deryugina AV, Oshevensky LV, Talamanova MN, Shabalin MA, Khlamova YuN, et al. (2016) Influence of terahertz electromagnetic radiation on prooxidant processes in erythrocytes. Biological Sciences 1(43): 103-104.

17. Plakhova VB, Podzorova SA, Mishchenko IV, Bagraev NT, Klyachkin LE, et al. (2003) Sensor systems.

18. Betsky OV, Krenitsky AP, Mayborodin AB et al. (2003) Biophysical effects of terahertz waves and prospects for the development of new directions in biomedical technology: "Terahertz therapy" and "Terahertz diagnostics". Biomedical Technologies and Radio electronics 12: 3-6.

19. Gerasimchuk NN, Kovaleva ON (2007) Plasma level of 8-isoprostane in the dynamics of combined antihypertensive therapy in overweight patients. Ukrainian the rapeutic journal 2: 26-31.

20. Zaika MV, Kovaleva ON (2006) 8-isoprostane as a marker of oxidative stress in patients with chronic heart failure. Ukrainian banner network.

21. Gerasimchuk NN, ON Kovaleva, NA Safargalina-Kornilova (2012) The level of 8-isoprostane, the activity of superoxide dismutase and catalase in hypertensive patients with overweight and obesity. Cardiovascular therapy and prevention 11: 33.

22. Gerasimchuk NN (2018) 8-isoprostane as a major marker of oxidative stress. Zaporozhye Medical Journal 20 No 6 (111): 853-859.

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