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THE INFLUENCE OF THE MEAL AND EMOTIONAL TENSION ON THE CONTENT OF GHRELIN AND LEPTIN IN THE BLOOD SERUM OF PERSONS CHARACTERIZED BY DIFFERENT TONUS OF THE VEGETATIVE NERVOUS SYSTEM

ABSTRACT. 34 persons aged 18-22 have been examined in order to compare the serum levels of hormones ghrelin and leptin in the morning in a fasted state and 15 and 45 minutes after consuming a standard breakfast of protein (100 g of meat in the form of burgers and 200 ml unsweetened tea) at rest and after a situation of emotional stress. Taking into account the initial tone of the autonomic nervous system and mathematical analysis of the heart rate variability, all the examinees were divided into three groups: normotonics, vagotonics and simpatotoniks. We stated that predominance of the parasympathetic or sympathetic nervous system tone implies differences in the content of ghrelin and leptin levels at rest and after the joint influence of a protein breakfast and emotional stress. A significant increase in the concentration of leptin after protein breakfast and emotional stress is characteristic of simpatotoniks, and increasing concentrations of ghrelin in the 45th minute were found in vagotonics.

KEY WORDS. Ghrelin, leptin, concentration, vegetative state, protein breakfast.

In 1999 Dr. M. Kojima et al. from the National Center for Cardiovascular Research in Osaka (Japan) studied the growth hormone secretagogue receptor, GHS-p and its influence on the growth hormone. In the course of these studies the scientists discovered a new peptide consisting of 28 amino acid residues which is capable of interaction with GHS-p autoreceptor thus increasing somatotropin release. This hormone was called ghrelin (from ghre – grow) [1]. It is produced by parietal cells, hypothalamus [2] and kidneys [3].

Ghrelin binds to the specific receptor of the cell membranes which belongs to transmembrane C-protein coupled receptors and is found in many organs and tissues: hypophysis, hypothalamus, digestive system, heart, lungs, blood vessels, adipose tissue, and cells of the immune system [4]. Binding to the receptors ghrelin leads to activation of protein kinase C with the further calcium release from the intracellular store and slowdown of potassium channels [5]. The stimulating influence of ghrelin on the secretion of the hypothalamus somatotrophic hormone is well known. Recent research have demonstrated the role of ghrelin in the regulation of energy balance and body weight as well as carbohydrate metabolism. It is supposed to be one of the factors defining eating behavior.

Ghrelin is even called the "hunger hormone" [6]. Its capability to speed up stomach evacuation is also of physiological importance. As a regulator of energy balance and food ingestion ghrelin also interacts with the peripheral regulatory systems. The contrary impact of ghrelin and leptin on appetite, food consumption and weight has been revealed. It is commonly known that leptin is a hormone which is produced in the cells of fatty tissue and which suppresses appetite and food consumption.

Leptin is a recently discovered protein hormone close in its structure to the first class of cytokines secreted by fatty cells and controlled by the gene responsible for obesity [7].

Discovery of leptin, hormone of peptide nature suppressing appetite and participating in the system of bodily energy balance, in 1994 attracted attention of the scholars dealing with the problems of obesity. Increase in leptin production precedes the increase in the content of all the hormones responsible for the reproductive system development during puberty. Probably when an optimal amount of fatty tissue is accumulated, leptin sends signals to the hypothalamus and the system hypothalamus — hypophysis — gonads, which controls the puberty process, is launched (Fruman M. E., 1993). In the course of puberty the blood level of testosterone increases and leptin secretion decreases (Mantzoros C.S., Flier Y. S., Rogol L. D. 1997). In connection with this, the study of the role of leptons in pubertal duspituitarism, its interrelations with the insulin level, sex hormones, insulin-resistance and indicators of the adipose and carbohydrate metabolism become especially vital.

Research methods. 34 males aged 18-22 have been examined in order to compare the serum levels of hormones ghrelin and leptin in the morning in a fasted state and 15 and 45 minutes after consuming a standard breakfast of protein (100 g of meat in the form of a cutlet and 200 ml unsweetened tea) at rest and after a situation of emotional stress. We had two series of observation: 1 — at a relative muscle and emotional relaxation; 2 — right after taking an examination (emotional stress).

With the help of the programmable apparatus "Varicard 2.51" we studied the initial tone of the autonomous nervous system. Based on the results of the mathematical analysis of the heart rate variability all the male subjects were divided into three groups: normotonics, vagotonics and sympathotoniks.

Before and 15 and 45 minutes after the protein breakfast we took blood samples from the cubital vein. We defined ghrelin and leptin levels in the blood serum with the method of ELISA using the following commercial equipment: analyzer "CHEM-7" and kits produced by DRG (USA). The obtained data were processed with "Excel 2000" and "Statistica 6.0" software.

Research findings and their discussion. At muscular and emotional rest before breakfast we found differences in the amount of leptin and ghrelin in the samples of the persons of different tones of their vegetative nervous systems (fig. 1, 2).

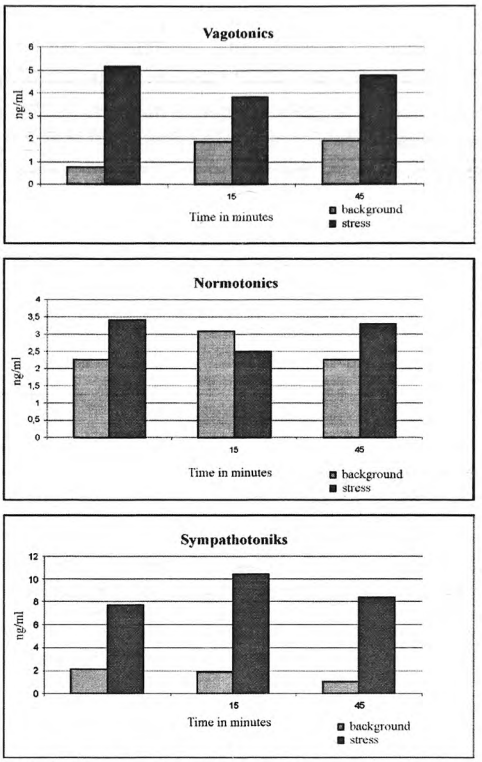

Fig. 1. The influence of protein breakfast and emotional tension on the dynamics of leptin release

differences are valid in comparison with the values under rest

The highest ghrelin values were registered for the normotonics as compared with the vago-and sympathotonics. The highest leptin values under the same conditions were registered for the normotonics.

The protein breakfast (100g. meat + 200 ml of unsweetened tea) caused differently directed changes in the content of the hormones in question. After 15 and 45 minutes leptin concentration increased in the vagotonics and decreased in the sympathotonics. As for the normotonics the amount of leptin after the protein breakfast did not change.

Ghrelin dynamics under these conditions was rather contradictory. As for the vagotonics and normotonics it decreased after 15 and 45 minutes; quite the opposite for the sympathotonics it increased.

Of special interest are the data on the influence of emotional tension and protein breakfast on leptin and ghrelin release dynamics among the people with different tones of the vegetative nervous system.

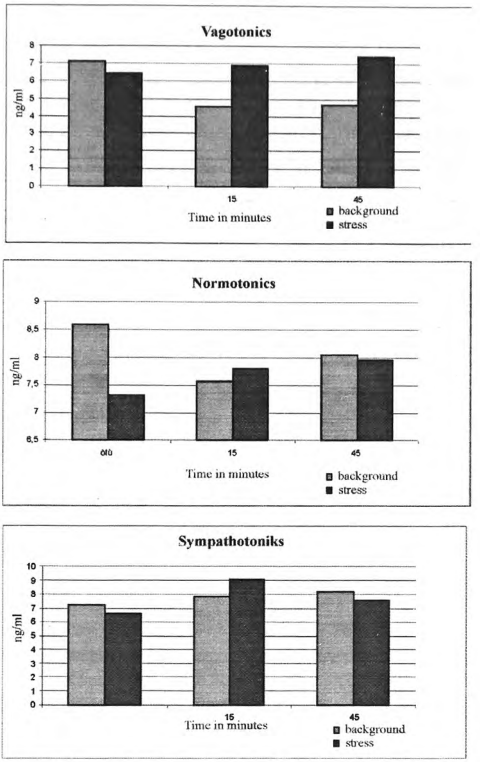

Fig. 2. The influence of protein breakfast and emotional tension on the dynamics of ghrelin release

differences are valid in comparison with the values under rest ($p<0.05$)

Without meals emotional tension insignificantly decreased ghrelin concentration and significantly influenced on leptin concentration in all the three test groups. The highest hormone concentration was registered for the sympathotonics ($p<0.001$) and vagotonics ($p<0.05$).

In 15 minutes after the combined impact of the protein breakfast and emotional tension the sympathotonics demonstrated a considerable increase in the hormone content ($p<0.001$); the normotonics tended to have decreased leptin in blood serum. 45 minutes after breakfast and emotional tension leptin concentration increased in all the test groups; but it was especially obvious with the sympathotonics.

As for ghrelin release dynamics under such conditions we recorded its increase 45 minutes after the combined impact of the protein breakfast and emotional tension only among the vagotonics ($p<0.01$).

Huda M.S.B. et al. [8] stated that ghrelin injection in a dose of 5pmol/kg/min to healthy people suppressed activity of the sympathetic and, to a lesser extent, parasympathetic nervous system. Vagotomized patients did not react to ghrelin injection, which let the authors of the research conclude that the nervus vagus participated in the hormone activity. Rosicka M. et al also mentioned participation of the central nervous system in ghrelin secretion [9].

Under intensified catabolic reactions, which can be observed under emotional tension, ghrelin level increases and, as a consequence, appetite increases. This in turn accelerates food consumption, digestion and stomach evacuation and interdependence with ghrelin level. All this provides for the necessary inclusion of nutrients into the muscle and adipose tissues (Casanueva Felipe, Dieguez Carlos) [10]. The authors suppose that such ghrelin activity is a "mirror" reflection of leptin activity which causes decrease of food consumption and body fat. Thus both peptides act as long-term physiological regulations of energy balance.

Conclusion. The conducted research let us claim that depending on the domination of the parasympathetic or sympathetic nervous system tone there are differences in ghrelin and especially leptin content both at rest and after a meal (a protein breakfast combined with emotional tension). The significant increase in the release dynamics after the influence of the protein breakfast and emotional tension is typical for the sympathotonics; ghrelin increase was detected among the vagotonics only 45 minutes later.

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