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MORPHOGENESIS OF SUDDEN CARDIAC DEATH IN HYPERANDROGENEMIA ON AN EXPERIMENTAL MODEL

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Abstract: The work summarizes literature data on the effect of testosterone and its synthetic derivatives on the body of athletes. The biosynthesis and metabolism pathways of testosterone, the testosterone signaling pathway, and its main biological effects are characterized. The main attention is paid to the problems of hypo- and hyperandrogenemia, as two extreme manifestations of deviation from the physiological level of testosterone in the blood in men. In this regard, prospects for further research were identified: the effect of hyperandrogenemia on the cardiac muscle in athletes and men using natural and synthetic testosterone analogues as means of increasing physical endurance and activity.

Keywords: Sudden cardiac death,anabolic steroids,athletes, hyperestrogenemia, cardiomyocytes.

INTRODUCTION

Sudden cardiac death is a pressing problem in modern clinical medicine. Every year, several million people die suddenly around the world. For example, in the USA, sudden cardiac death claims about 350 human lives [1]. In addition, these are predominantly people of a creatively active age, which determines the social significance of this problem. Thus, in the United States, sudden cardiac death among men aged 20 to 64 years accounts for 32% of all causes of death.

MATERIALS AND METHODS

Cases of sudden cardiac death among athletes during physical activity are rare. For obvious reasons - after all, playing sports has a positive effect on the human body as a whole: it strengthens muscles and increases body mobility.

According to a prospective population-based study conducted in the Italian region of Veneto, an average of 2.3 cases of sudden death were recorded (2.6 cases among men and 1.1 among women aged 12 to 35 years) per 100 thousand. athletes for all causes and 2.1 cases of sudden death per 100 thousand athletes per year due to diseases of the cardiovascular system [2]. Previous retrospective studies have shown lower rates of sports-related sudden deaths in the United States.

S.P. VanCamp et al. According to the results of a national study, they indicated the presence of 0.4 sudden deaths per 100 thousand people per year among athletes, high school and college students [2]. According to B.J. Maron et al., the incidence of sudden death during physical activity in high school athletes (13–19 years old, average 16 years old) living in Minnesota was 0.35 per 100 thousand cases and 0.46 per 100 thousand athletes per year (0.77 per 100 thousand male athletes). Higher rates during physical activity (from 1:15,000 to 1:50,000) were recorded among apparently healthy male runners or marathon participants.

RESULTS AND DISCUSSION

Androgens are derivatives of the cyclic hydrocarbon cyclopentanperhydrophenanthrene, consisting of three six-membered and one five-membered ring. Testosterone belongs to the class of androstane steroid hormones, which are derivatives of the C-19 steroid androstane; its structure was first deciphered by David in 1935. When testosterone is formed, a double bond

appears in the structure of androstane between the 4th and 5th carbon atoms, the hydrogen at the 3rd carbon atom is replaced by a keto group, and at the 17th atom - by hydroxyl [1]. The functions of sex steroids are realized through binding to specific intracellular receptors, which leads to the activation of ligand-dependent transcription factors, as well as through membrane receptors, which stimulates some signal transduction pathways. In the first case, testosterone diffuses across the plasma membrane and interacts with cytoplasmic androgen receptors (AR) associated with heat shock proteins.

Biological effect of testosterone

Testosterone is one of the main androgenic hormones and has a wide range of biological effects. The classic effect of testosterone is the induction and maintenance of secondary sexual characteristics, libido, muscle mass and bone density. Testosterone inhibits the secretion of gonadotropin and, accordingly, the synthesis of LH by the pituitary gland via a negative feedback mechanism [13]. In men, testosterone levels reach their maximum by the age of 30, and then decrease annually by 1–2%. At the same time, due to age-related changes in the hypothalamic-pituitary system, the level of androgenic activity of the testicles decreases under the influence of gonadotropic hormones on them. With age, there is an increase in the level of SHBG (Sex Hormone Binding Globulin, or steroid-binding globulin) by 1–2% per year, so the decrease in the level of free, biologically available testosterone is more pronounced than total testosterone. An age-related decrease in testosterone levels is accompanied by an increase in the amount of adipose tissue in the body and a decrease in bone and muscle mass. Reduced muscle mass is one of the reasons for the development of a high risk of strokes, obstructive apnea, obesity, type 2 diabetes mellitus, depression, chronic obstructive pulmonary disease, kidney and liver diseases [2].

The effect of anabolic androgenic steroids on the heart muscle

Long-term use and abuse of AAS can cause a large number of different pathological changes in the cardiovascular, reproductive, endocrine, urinary systems, musculoskeletal system, and also in the liver. These changes are related to the dose and frequency of use. In certain cases, pathological changes in these organs and systems can lead to death. AAS have a special effect on the cardiovascular system, being a cause that increases the risk of sudden cardiac death [3], myocardial infarction, increased serum lipoproteins, left ventricular hypertrophy, increased pressure, decreased systolic function and many others.

CONCLUSION

Studies of the effects of testosterone are carried out mainly in an in vitro experimental system, which limits our understanding of the physiological effects of this hormone on the human body. Currently, data on the effect of increased testosterone levels on the heart muscle are rare, which determines the relevance of scientific research in this area. Thus, the study of the heart muscle under the influence of elevated testosterone levels in an experimental model will reveal the course and features of morphological changes in cardiomyocytes during hyperandrogenemia. And also assess the health risks of athletes taking anabolic steroids.

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