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Original article

EXERCISE AND HYPOPHYSIS HORMONES

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Abstract*

Aim. It is stated that the exercise applications caused many changes in blood hormone levels. These changes can affects the athlete's performance positively or negatively. Two main mechanisms constitute the homeostatic structure of organisms against internal and external conditions described as nervous system and endocrine system.

It is reported that the endocrine system provides the organization of various systems depending on the changes in the internal and external environment. This chemical agent produced by glands in the body and transmitted to the target cell by the circulatory system is defined as hormone. Hormones are grouped under three headings according to their chemical structure as amine, amino acid, polypeptide, protein or steroid structure. Endocrine system undertakes the task of responding to adaptation and physiological responses to exercise due to the structure of intracellular functions.

Because of the exercise effects on the endocrine system affects the whole homeostatic systems, has increased interests in this field. Athletes usually provide muscle development with exercise. Sufficient amounts of amino acids should be taken and stored into organisms for provision of muscle development and protein biosynthesis. Protein synthesis and growth functions of organism occur with hormones called somatotropin line as GHRF, GH, IGF. This situation makes it more attractive to determine the effects of exercise on hormones.

Conclusion. It is stated that the duration of increase and decrease in human blood concentrations is important. The duration of action of hormones can show differences. While a hormone showed effect in seconds, the effect of another hormone may take hours or days. Although the increase in blood hormone levels reported to be due to the endocrine system, exercise-induced hormonal changes reveal the necessity of more extensive research on this topic.

Keywords : Exercise, Hormones, Hypophysis Hormones

Introduction

It was determined in many research conducted that exercise in athletes causes important changes in hormone levels in blood and these changes affect the performance of athlete negatively or positively (Akgün, 1994).

Endocrine system provides the organization of various systems depending on variations in external and internal environment. This organization is provided with chemical mediators which are produced by glands, transmitted to target cell in circulation system and called as hormone. These hormones are substances having amine, amino acid, polypeptide, protein or steroid structure. Due to regulation in cellular functions, endocrine system is held responsible for many physiological responses and adaptation to exercise (Williams, 1995).

Hormones are collected under three groups as protein or peptide structured hormones, amine structured hormones, steroid structured hormones by their chemical structures (Kalaycıoğlu et al., 2006).

Many hormones take effect firstly by providing cAMP (3'-5'-adenosine monophosphate) formation within the cell. After cAMP is formed, effect of the hormone is started to be seen within the cell. For this reason, cAMP features an intracellular hormonal mediator (Kalaycıoğlu, et al., 2006).

Hypothalamus is a part of central nervous system and has established neural ties with other regions of the brain and all internal organs. Hypothalamus is a bridge connecting nervous system with hormone system (Motta, 1991; Williams, 1995). Hypothalamus is in connection with hypophysis gland placed slightly under itself in the brain anatomically. Hypophysis gland is consisted of two parts as adenohypophysis and neurohypophysis. There are fibers and blood vessels within hypophysis stem. Communication between hypothalamus and hypophysis is realized by means of these vessels and nerves (Granner, 1998). Some hormones stimulating hypophysis from nerve endings resulting from hypothalamus are released (Kalaycıoğlu, et al., 2006).

Particularly ACTH, LH, FSH that are hypophysis frontal lobe hormones, vasopressin, parathyroid hormone (parathormone) from posterior lobe

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hormones, glucagon, epinephrine (adrenalin) and secretin from pancreas hormones and factors released from hypothalamic region are hormones affecting with such receptor system (Bingöl, 1983). Growth hormone (GH) released from anterior hypophysis and called as Somatotropin is a hormone featuring protein structure, as well as ACTH, TSH, FSH, LH. It varies by species in terms of amino acid number it bears. Human growth hormone is established from 188 amino acids. It is a hormone containing single polypeptide chain and two disulphide bonds in human and monkeys (Kopchick et al., 2002, Bhogavan, 2002).

How long the hormonal effect takes is also important as well as the increasing blood concentration of hormones during the exercise. While some hormones take effect and break down within seconds, effect of some hormones may last for hours or days. Although it is known that the increase in hormone concentration is resulted from the increase in production of endocrine, the increased hormone concentration may not cause an increase in target tissues in the expected affect (Akgün, 1994). Changes in the hormonal response to the exercise present the necessity for conducting more research in this regard.

It was found that as the intensity of exercise increases, growth hormone released from anterior lobe of hypophysis increases. While no increase was found in growth hormone blood concentration in low exercise loads in study conducted in bicycle ergometer, it was observed that 35 times more hormone levels than resting state were reached in the high exercise loads. It is suggested that the increase in growth hormone plays a tole in fatty acid mobilization and metabolism required for long-lasting of endurance particularly in endurance sports (Güner, 1992).

It is argued that this increase in growth hormone concentration is caused by increasing body temperature during the acute exercises, not by the exercise directly. However, there are conflicting opinions in this regard. In a study conducted, it was found that there was increase in growth hormone concentration in parallel to the increase seen in body temperature in the onset of the activity exercise having the same load, however it was determined that decreases were seen in growth hormone concentration against increasing body temperature in the next stages of exercise. In another study conducted, it was determined that increase seen in growth hormone concentration caused by the increase in body temperature in hot baths and saunas is quite lower than the increase seen during the exercise (Çolakoglu, 1995).

Growth hormone response of the individual to exercise is closely related with exercise state of that person.

- Growth hormone concentration hormone in a trained person is lower compared with an untrained person.
- Decrease in growth hormone concentration in a trained person after a tiring exercise is lower compared with an untrained person.

While mechanism of this difference is not fully known, it is considered that decrease in growth hormone concentration during the long-term exercise is based on decreasing psychological stress over time (Akgün, 1994).

Blum et al. (1993) determined growth hormone values of untrained persons and bicycle racers in his study and it was observed that growth hormone levels were similar in both groups at quiet. However, GH level in untrained subjects during the exercise was found higher. GH concentrations of bicyclers fell during the exercise, however they continued to increase in untrained subjects. These results support the findings showing a lower increase in plasma GH levels when well-trained subjects were compared with inexperienced ones. But, the effect of exercise on GH variations is still a questionable issue.

The growth hormone that is a strong anabolic affects all systems of the body and has an important role in development of muscles. GH release from hypothesis is increased by various amino acids and drug administration as well as factors such as sleeping, exercise, stress (Fein et al., 1975; Macintyre, 1987; Flanagan et al., 1997; Jenkins, 1999).

It has been reported that growth hormone increases glyconeogenic and lipolytic, hence it is important that supporting the sufficient energy for acute exercise (Ergen 2002).

Growth hormone has anabolic effects on the connective tissue and muscle. It has been stated that these effects of growth hormone causes increases skeletal and muscle mass (Calfee et al., 2006,; Berne 2008). It has been mentioned that growth hormone is used as doping agent by sportsmen depend on its anabolic effects on the muscle mass (Brooks, 1985).

Serum GH level is affected by age, gender, body composition and exercise state. It was shown that injections of growth hormone cause muscle hypertrophy in atrophy and weaknesses formed surgically with animal experiments. However, it was reported that hypertrophy occurred did not affect muscle strength (Macintyre, 1987; Jenkins, 1999). All haemostatic systems are affected by exercise and this state increases the interest for reviewing the effects of exercise on endocrine system. Athletes try to provide

stimulation of muscle development particularly with exercises. Keeping amino acids in adequate amounts available for protein biosynthesis in other words muscle development is compulsory. Since protein synthesis in organism body and growth of the organism realize in the line consisted of hormones such as GHRF, GH, IGF called basically as somatotrop, effects of exercise on hormones included in this line have become more interesting (Galbo, 1985; Flanagan et al., 1997).

In 1 hour of tiring bicycle ergometer test performed on triathelets, elevation in GH levels in circulating blood, elevation in GH and IGF levels discharged in urine in bicyclists were accepted as indicator of effects of exercises on somatotrop line. However, it is argued that standardization of some criteria such as type, intensity, duration of exercises and previous exercise states of athletes is compulsory and preliminary preparation stages are necessary due to advanced-level releases emerging in blood growth hormone level depending on the stress developing in individuals who start to exercise without passing a preliminary preparation stage, for presenting these effects completely (Galbo, 1985; Flanagan et al., 1997). Naturally the first studies in this direction were conducted on GH that is the basic member of somatotrop line, it was found that elevation in GH levels after the exercises was followed by the increase of GH amout discharged in the urine. However, it was emphasized that this phenomenon could not be originated from the exercise effect directly (Flanagan et al., 1997; De Palo et al., 1998; De Palo et al., 2001).

Nguayen et al., (1998) considered that exercise type may be effective on blood GH, IGF-1 and IGFBP levels and they found that the biggest effects emerged during the bicycle ergometer exercises conducted in such a way which would tire the athlete well and this ergometer had no quite much effect on levels of exercises performed in skiers and football players (Nguayen et al., 1998). Also, while GH and GHBP levels increased as acute effects of exercises, an acute change could not be observed in IGF-1 and IGFBP levels and it was highlighted that long-term research are needed for reviewing these effects (Zancanato et al., 1994, Willis et al., 1997). Wideman et al., (1999) examined changes of effects of exercises on somatotrop line by gender and they found that the required period for reaching maximal blood GH levels during aerobic exercise is longer in males compared with females (32 minutes in males, 24 minutes in females), however there was no difference between females and males in terms of maximal GH concentration reached. Wallace et al., (1999) who examined the effects of long-term exercises on somatotrop line in more detailed way found that while total blood GH, GHBP, IGF-1, IGFBP-3 levels were increasing, no change was seen in free IGF-1 concentrations, IGFBP-1 levels varied individually and particularly all parameters increased after the exercises.

In the long-term exercises, an apparent water and sodium loss occurs. During the exercise, it is provided to minimize the dehydration (fluid loss) by releasing (Vasopressin) ADH from neurohypophysis and renin from kidneys (Akgün, 1994). Releasing of ADH also increases during the exercises. Increasing ADH provides fluid retention by activating the collecting channels after the excessive exercise. This situation is important for protection of body fluids during the exercise. ADH levels return to normal after about 1 hour from the exercise. It is reported in sources that ADH increases in rate of 30-80% during the exercise. The increase seen in ADH levels is proportional with the intensity of the exercise. Reduction in plasma volume and increase in osmotic activity of blood as a result of perspiration may be correlated with ADH increase. Also, it was seen that increase in ADH levels in fluid areas prior to the exercise and after the exercise was lower (Akgün, 1994; Guyton, 2001).

Adrenocorticotropic hormone (ACTH) belongs to pituitary hormone and it is a protein hormone. ACTH secrets glucocorticoids, they have 39 amino acids, from adrenal gland (Aron, 1997, Korkmaz, 2010). ACTH regulates or increases cortisol and may hormone synthesis within the circulatory system (Aron, 1997). ACTH has 4-18 hours as half-life, level of ACTH increases after exercise and this effect may be related with cortisol level (Ergen, 2002).

It has been stated that higher ACTH levels are observed in constantly exercised humans or sportsman. In addition, acute or anaerobic exercise may increase blood ACTH concentrations (Ünal 1998).

Luteotropic hormone which is called as lactotropic hormone stimulates milk production that is the basic function of prolactin in females (Guyton, 2001).

In addition, prolactin may effect gonadrofin releasing, and effect gonads and extraction of water from kidneys. Dopamine hormone is secreted from hypothalamus and it regulates prolactin physiology in the body (Mancini, 2008).

Prolactine is the only hormone whose release is controlled with inhibition, among anterior hypophysis hormones. Tumor development in supracellular region between hypothalamus and hypophysis, interruption of hypothalamus-hypophyseal portal circulation cause secretions of all anterior hypophysis hormones, excluding prolactin, to be ceased. Prolactin

secretion increases. This is because, hypothalamic factors stimulating the secretion of anterior hypophysis hormones and suppressing the secretion of prolactin in the same way could not reach hypophysis (Bingöl, 1983).

It has been mentioned that negative control of dopaminergic system effects prolactin secretion, prolactin inhibiting factor (PIF) inhibits prolactin secretion, and prolactin releasing factor (PRF) and TRH stimulate prolactin hormone secretion (Utama, 2006).

It has been not fully understand that effect of exercise on the prolactin concentrations. However, it is known that increased prolactin concentrations associated with body temperature, hence it may be stated that exercise effects prolactin hormone level (Utama, 2006, Brissona, 1986, Gündüz, 1992)

Blood concentration of prolactin also increases during the heavy exercises, like growth hormone. However, it was determined that blood concentration of prolactin increased somewhat with gentle exercises. In a study conducted in females, it was found that prolactin increase was seen only in females who had a sportive history in 30 minutes of submaximal bicycle exercises. It is argued that prolactin increase based on exercise suppresses ovaries and thus, it causes menstrual cycle irregularities (Akgün, 1994).

Conclusion

Human blood concentrations and hormone actions can show differences. A hormone may effects within the seconds, hence; this hormone may effect another hormone activity within hours or days after secretion. These complicated systems of hormones may be associated exercise.

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