

The Role of the Pituitary-Adrenocortical Axis System in the Regulation of Secretion of Digestive Glands of Wrestlers During Sports and Postsports Ontogenesis

Sergei F. Panov^a, Irina P. Panova^a, Elena V. Volunskaya^a and Andrei V. Chebotarev^a

^aLipetsk State Pedagogical P. Semenov-Tyan-Shansky University, Lipetsk, RUSSIA

ABSTRACT

According to many researchers its necessary to research a hormonal profile in order to determine mechanisms of regulation of functions of the digestive conveyor during sports activities. In the paper the results of the carried out research on studying of a role of pituitary-adrenocortical axis system of adaptive reactions in activities of the secretory apparatus of a stomach of the athletes engaged in fight are provided. In our research the method of fractional gastric sounding was applied (as the most acceptable physiological method of a research of secretory activities of a stomach), and a method of the enzyme multiplied immunoassay by means of the industrial sets "CEA-IRE-SORIN" by means of which content of ACTH hormones, cortisol and aldosterone in blood serum was studied. Results of the carried out research complement data in the field of sports gastroenterology and sports medicine and specify the possibility of their use by trainers and athletes when planning training and competitive exercises exerciseand processes of recovery.

KEYWORDS

Athletes-wrestlers, bone-breaker, sport and post sport ontogenesis, pituitary-adrenocortical axis system, gastric secretion, cycloergometric exerciseexercise

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Introduction

The modern sport is characterized by a constant increase in the volume of training exercises and their intensity, which impact has a significant influence on the athletes' nature (Bykov, Kolomiets & Stepanov, 2015; Ehrlich, Isaev & Romanov, 2013.). The prerequisite and one of the important components of the training process of the athletes is the full recovery of disturbed homeostasis and reduced efficiency due to the exercisesexercise (Koryagina, Roguleva & Zamchy, 2013; Landor, Vider & Lepik, 2006; Kimber & Heigenhauser, 2003; Raja et al, 2007).

CORRESPONDENCE Panov S.F ✉ kafedrasporta@mail.ru

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Pituitary-adrenal axis together with the digestive conveyor and immune system plays an important role in replenishing the energy and plastic losses of the organism in the process of adaptive reactions in muscle activity (Trokhimchuk, 1999; Gryaznykh, 2011; Korotko 2013; Kuznetsov, Smelysheva & Sidorov, 2014; Smelysheva et al, 2014).

To determine mechanisms of regulation of functions of the digestive conveyor during sports activities (when the accomplishment of training exercises and competitive activities, as well as during the recovery period) the research of a hormonal profile is required (Kuznetsov, Smelysheva & Sidorov, 2014; Filaretova, 2014; Shaykhelislamova et al., 2014).

According to many researchers, in regulation of secretory function of digestive glands one of the important things is an influence of pituitary-adrenocortical axis system hormones (Hackney et al., 2003; Maton, 2005). According to the author (Ugolev & Radbil, 1995) adrenocorticotrophic hormone (ACTH) and glucocorticoids (cortisol) stimulate activities of the secretory apparatus of a stomach, in which case ACTH realizes the stimulating effect via glucocorticoids. In particular, in case of action of a stressful irritant, the ACTH participates in regulation of organism functions, and cortisol is intended for mobilization of nutrients, turning proteins into amino acids, and glycogen into glucose.

In the researches carried out earlier authors revealed the decrease in the production of mineral corticosteroids when gastric ulcer, and recommended to use mineral corticosteroids for treatment of this disease (Radbil & Weinstein, 1973).

At the same time the fact of hypergastrinemia when ACTH and glucocorticosteroids (exogenous hormones) administered, as well as with the presence of the pathology (Cushing's syndrome) was revealed, what confirms the information on the interconnected relationships of gastrin-creating and the pituitary-adrenocortical axis system.

Also, in the literature there is information about the presence of the inverse correlation relationship between the level of plasma gastrin and cortisol level among adolescences athletes, characterized by hyperactivity of gastric glands. ($r = -0.51$; $p < 0.05$). The authors also emphasize the availability of coefficient of correlation acid-forming function of a stomach / mineral corticosteroids activity of suprarenal cortex ($r = 0.59$; $p < 0.05$) among high-class long-distance runners, whose is characterized by hyper secretion of hydrochloric acid (Pleshakov & Shiryaev, 1987).

According to researches, devoted to the questions of studying of endocrine mechanisms of the secretory apparatus regulation, the higher background concentration of level of sports adrenocorticotrophic hormone and cortisol is found in comparison with people not involved in sports (Kuznetsov, Smelysheva & Sidorov, 2014).

In the researches devoted to the studying of level of hormones of pituitary-adrenocortical axis system it is found, that in the ascending ontogenesis there is the wavy rise of concentration of an adrenocorticotrophic hormone (ACTH) and forward increase of content of cortisol (Selverova & Filippova, 2000).

Studying of features of formation of gastric digestion is one of urgent problems of modern age-specific physiology because of the need of knowledge of various pathologies of the gastrointestinal conveyor, diagnostics and prevention of their emergence (Dzgojeva, 2013; Hackney, Cook Summer & Ploutz-Snyder, 2011).

In the analysis of the literature devoted to the studying of age-features of formation of gastric digestion pituitary-adrenocortical axis system in imperfect (urgent) and stable (long-term) adaptation of the secretory apparatus it is possible to

draw a conclusion, that researches on these problems are insufficient, and their obtained data are very contradictory. Indistinct matching of age groups, various sounding techniques, the use of unequal tests and various stimulators of digestive glands – all these factors influence uniformity of results and complicate their interpretation.

Thus, the fragmentariness of the listed researches doesn't give a complete picture about a role of adrenocorticotrophic hormone, cortisol and aldosterone in long-term and urgent adaptation of secretory function of glands of a digestive tract among athletes in all stages of sports training life and after completion of sports career. In our opinion, it is possible to assume the availability of a peculiar dynamics, which shall be known not only by specialists in the field of gastroenterology, sports medicine, but also by trainers and athletes.

For the solution of the problems sounded above as on a research object we stopped our attention on the athletes wrestled, because of their active process of rejuvenation and mass character of this sport, and discrepancy of the existing data on preventive and pathological influence of systematic training workloads on digestion system.

The aim of this research was to follow the participation of the pituitary-adrenocortical axis system in the imperfect (urgent) and stable (long-term) adaptation of gastric secretory apparatus of wrestlers during the period of sport and post sport ontogenesis.

Methodology

The biggest time of our research which covered the 25-year period, chronologically partially matched with the ascending ontogenesis, it is passed in trainings and competitions, and we call its sports ontogenesis. Much smaller interval (about 7 years) is connected with completion of sports career of athletes, and we call its post-sports ontogenesis.

Under the terms of a research, proceeding from the purpose and objectives, we determined the contingent of the athletes wrestled-169 fighters aged from 7 up to 32 years. 9 groups of examinees of the following age categories were created: period of the second childhood; teenage age; youthful age; mature age.

According to the requirements of ethical committee all participants gave a voluntary consent to the participation in an experiment, and minor examinees - with the official permission of the parents.

All examinees were registered in medical-sports clinic, where they annually had taken medical examination.

In our research all indicators are given both in absolute and in relative units (i.e. per kilogram weight of examinees). In our opinion, such recalculation, first, gives more necessary specific information for athletes engaged in those sports where there is a division into weight categories by the rules of competitions. Secondly, in our opinion, when comparing relative indicators, the significance level of the received results shall be increased.

In our research the method of fractional gastral sounding (as the most acceptable physiological method of a research of secretory activities of a stomach) was applied by means of which the functional state of gastric glands of athletes -wrestlers was studied. Sounding was carried out at rest and right after accomplishment of exercise machine (pedalling on a bicycle ergometer).

Stimulation of digestive glands took place under the influence of cabbage juice in the amount of 200 ml (10% broth) which is an effective stimulator of a neurohumoral phase of a producing and it is similar to foodstuff.

In all fractions of gastric glands discharge we considered the amount (ml/hour), pH, concentration and an output hour of hydrochloric acid (mg/hour).

In gastric acid we determined concentration and gross output (output hour) of a pepsinogen (mg/hour) and total proteolytic activity of natural gastric acid (mg/hour) in case of an initial pH.

The pH-metry method (a potentiometer pH 340) and a classical method of titration were applied when determining acid-forming function of a stomach.

To determine indicators of basal and stimulated secretion in dynamics, we had to collect content separately on 15-minute portions in different containers within an hour.

Based on the Lipetsk regional hospital in the clinical diagnostic laboratory of the radioactive isotopes the content of ACTH hormones, cortisol and aldosterone in blood serum was researched by the method of enzyme multiplied immunoassay by means of the industrial sets "CEA-IRE-SORIN" (France, Belgium, Italy) and according to the instructions.

As the physical testing activity within 20 minutes we used the exercises on the bicycle ergometer with a frequency of rotation of pedals of 75 turn/min and standard capacity (for all participants of a research about 2 W/kg of body weight, taking into account heart rate and the size of the oxygen maximum consumption). We relied on the facts given by authors, that when performing the workload at the level of not lower than 60% of the oxygen maximum consumption, the activation of humoral and hormonal regulatory mechanisms is taking place.

The obtained experimental data were processed by the method of the variation and correlation analysis with the use of application programs "Statistica 5.11", "Excel 2003". For assessment of reliability the Student-Fischer's criterion was used - in case of probability at least of 95% ($p < 0,05$) distinctions between the compared indicators were considered as reliable. The coefficient of correlation (r) was calculated for detection of narrowness and an orientation of interrelation between the researched sizes.

Results and Discussion

In the result of the carried out research it was revealed that throughout sports and post-sports ontogenesis 3 critical periods are observed: the age of 6-7 years – the beginning of training activities; the age of 13-16 years – growth of competitive activities and the first achievements in sports life; the age of 25 years-32 of year – completion of sports career.

In the first 7 years of sports ontogenesis in result of moderate growth training (from 6 to 10 hours in a week) and competitive exercises and moderate growth of body weight (about 1,3 kg a year), the athletes reactivity of digestive glands increases relative to background level and the level of proteolysis increases that leads to hyperfunction.

In the next 4 years of sports ontogenesis there is a sharp increase in amount and intensity of training and competitive exercises, approximately six-kilogram increase in weight of the older young men and sharp transition from initial to a final stage of puberty (1-2 stage of puberty among children, and 4-5 - among older teens and younger boys). All above-mentioned factors are combined with low reactivity of gastric glands both low level of a proteolysis (hypofunction) and endocrine shifts.

Thus, in the process of increase in experiences of training sessions and growth of sports qualification throughout all sports ontogenesis (7-25 years) we observe decrease in indicators of gastric secretion relative to the background level. This fact could be estimated from different perspectives: as economization of function and as its depletion.

However, we consider that the relative decrease in indicators of secretion demonstrates more economical and effective functioning of biological systems. The confirmation of it is the dynamics of a total indicator of proteolytic activity as integrated indicator, which reflects a real picture of activities of digestive glands (Korotko, 2013).

Throughout sports and post-sports ontogenesis and in particular among athletes of the advanced teenage age, younger and advanced youthful age, adult and former athletes we observe sharp decrease not only of background basal indicators (especially) and stimulated total proteolytic activity, but also in comparison with their unexercised peers.

By results of our researches it is noted that the dosed cycloergometric test exercise authentically increases proteolysis among wrestlers of all age groups which had the low background level of basic data.

We obtained data on sharp reliable increase in level of a basal proteolysis among adult athletes ($p < 0,01$), and these indicators exceed similar in all age groups. Such results can witness about rather significant the secretory allowances of digestive glands among athletes-wrestlers of high qualification who have a long experience of training and competitive activities.

Other situation is observed among athletes who had the high level of a background indicator of a basal proteolysis. Under the influence of physical activity the level of the basal proteolysis reduced to optimal values.

Analyzing indicators of proteolysis among the wrestlers, who finished their sports career, we also note the adjusting workload role - the level of a proteolysis authentically increases in the basal period of secretion ($p < 0,05$). We noted also, that between the level of proteolysis and the body weight there is a positive correlation dependence in the conditions of cycloergometric test exercises ($r = 0,43-0,58$; $p < 0,05$).

Materials of our researches demonstrate big set of adaptive secretory shifts in the exercise states. In our opinion these shifts, which may be observed during the different age periods of sports ontogenesis, are aimed to optimization of proteins hydrolysis and manifested in such functions as stability, lability, economization and high reserve opportunities.

We revealed direct dependence of the adaptive secretory shifts not only from age of athletes-wrestlers, but also from the level of their sports qualification and time of sports experiences.

Results of research of hormones level in blood among athletes-wrestlers at rest and after exercises are provided in the table.

Materials of our studies show, that in age dynamics the uniform increase in concentration of adrenocorticotrophic hormone (ACTH) on the background of ups and downs in content of cortisol is found among athletes fighters.

We observe absolute peaks in age dynamics of adrenocorticotrophic hormone (ACTH) concentration among athletes-wrestlers in the period of youthful age: athletes aged 17-18 of 73.7 ± 8.50 pg/ml and athletes ages 19-21 of 80.1 ± 4.20 pg/ml.

In the period of maturity, both among active sportsmen and athletes, who left training activities, we note stabilization of adrenocorticotrophic hormone (ACTH) concentration.

Table 1. Basal level of hormones in blood ($M \pm m$) of wrestlers in muscular rest and after physical activity state

Examinees groups	Age of examinees, years	n	Terms of research	Hormones concentration		
				ACTH, pg/ml	Cortisol, nmol / mL	Aldosterone, pg / ml
period of the second childhood	7-8	12	muscular rest	34.9 \pm 3.81	482.5 \pm 29.86	277.7 \pm 24.50
	7-8	12	exercise stress	36.2 \pm 3.57	450.2 \pm 31.50	308.3 \pm 32.57
	9-10	17	muscular rest	30.3 \pm 3.18	507.8 \pm 47.31	305.5 \pm 31.19
	9-10	17	exercise stress	30.7 \pm 3.31	470.2 \pm 50.20	309.1 \pm 33.16
	11-12	16	muscular rest	36.4 \pm 3.50	502.2 \pm 39.54	264.2 \pm 28.15
	11-12	16	физическая нагрузка	33.4 \pm 3.08	450.9 \pm 51.10	320.4 \pm 23.20
period of teenage age	13-14	14	muscular rest	41.3 \pm 3.80	530.0 \pm 20.00	135.0 \pm 10.00
	13-14	14	exercise stress	44.3 \pm 3.25	471.1 \pm 10.20	184.3 \pm 16.50*
	15-16	16	muscular rest	46.2 \pm 4.55	308.0 \pm 57.44	129.5 \pm 18.39
	15-16	16	exercise stress	49.2 \pm 3.20	321.2 \pm 27.11	140.9 \pm 10.90
period of youthful age	17-18	14	muscular rest	73.7 \pm 8.50	1078 \pm 104.58	168.7 \pm 14.18
	17-18	14	exercise stress	74.2 \pm 6.47	620.2 \pm 40.0	173.2 \pm 10.80
	19-21	15	muscular rest	80.1 \pm 4.20	802.7 \pm 90.43	141.7 \pm 12.01
	19-21	15	exercise stress	80.5 \pm 6.14	610.4 \pm 30.28	140.8 \pm 11.80
period of maturity	22-25	16	muscular rest	57.9 \pm 4.62	763.0 \pm 75.21	130.5 \pm 11.57
	22-25	16	exercise stress	59.1 \pm 4.50	613.1 \pm 30.00	139.2 \pm 8.10
	25-32	12	muscular rest	79.6 \pm 8.90	690.4 \pm 30.50	205.2 \pm 24.51
	25-32	12	exercise stress	79.6 \pm 9.10	480.4 \pm 25.20*	173.0 \pm 10.10

Note: n - number of examinees; * – distinctions are reliable by Student's t-criterion relatively to background values $p < 0,05$.

Figure 1 shows the dynamics of the ACTH concentration in the blood and indicators of basal total proteolytic activity of gastric acid among wrestlers in terms of muscle rest and after exercises on a bicycle ergometer. As can be seen on the figure, in adolescence age we are marking the first jump in the secretion of corticotrophin and among older youths the absolute peak in hormone secretion is registered.

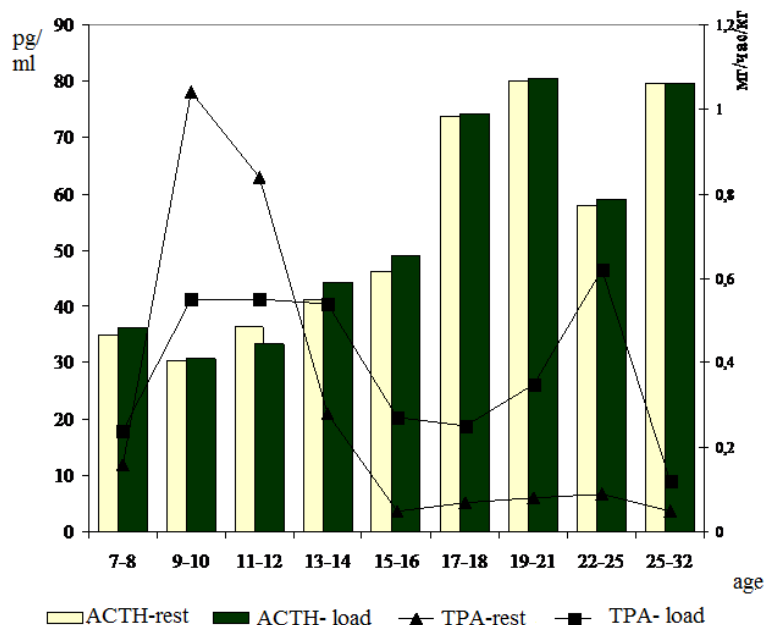
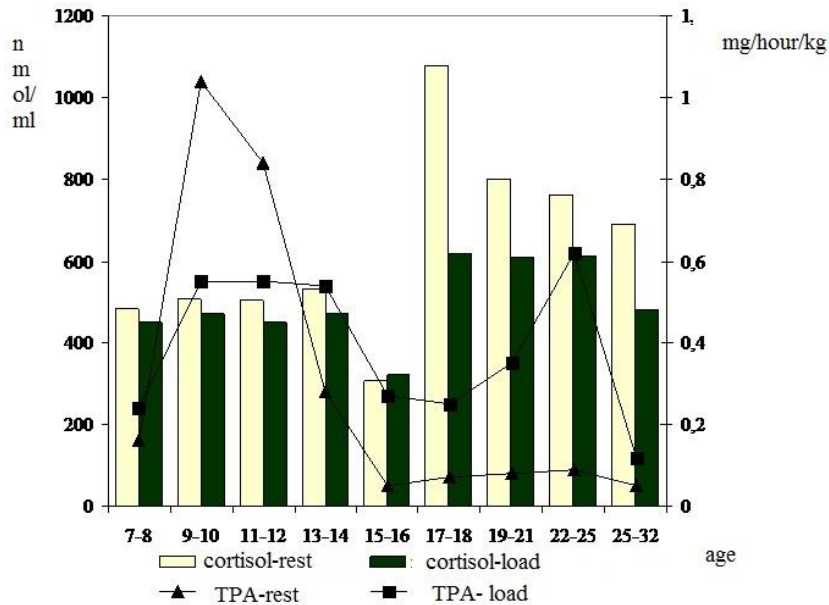


Figure 1. Dynamics of indicators of ACTH concentration in blood (pg/ml) and the basal total proteolytic activity (TPA) of gastric acid (mg/hour/kg) of wrestlers in the conditions of rest and after exercises

Having carried out the comparative analysis of the data of concentration of ACTH of athletes-wrestlers with the data from earlier made researches obtained not among athletes, it is possible to note the following fact: absolute indicators of ACTH of the athletes exceeded more than twice similar ones among their peers not engaged in sports (Selverova & Filippov, 2000).

The figure 2 shows the dynamics of indicators of concentration of cortisol in blood and indicators of basal total proteolytic activity of gastric acid of athletes-wrestlers in the states of rest and after exercises on the stationary bicycle.



Note: - reliability of distinctions ($p < 0,05$).

Figure 2. Dynamics of indicators of cortisol concentration in blood (nmol/ml) and the basal total proteolytic activity (TPA) of gastric acid (mg/hour/kg) of wrestlers in the states of rest and after exercise

As the figure shows, the level of cortisol (in absolute terms) of athletes in all age groups is in 1.5-2 times higher than the figures, obtained earlier in the research of N.B. Selverova & T.A. Philippova (2000).

The exception was constituted by the group of older teenagers, where we observe rather sharp drop of concentration of glucocorticosteroids in the slight increase of the ACTH level. However, in the period of youthful age there is the absolute peak gain in concentration of both cortisol (802.7 ± 90.43 nmol/ml), and adrenocorticotrophic hormone (80.1 ± 4.20 pg/ml) is noted.

However, when we counted indicators of ACTH and cortisol for kilogram of body weight of examinees, it turned out that wavy progressing nature of level of hormones secretion changed a little and became more smoothed, but kept in general its age dynamics.

Data of our researches revealed, that athletes-wrestlers of all age categories have no correlation interrelations between the ACTH level and indicators of the secretory apparatus of a stomach both in state of muscular rest, and after cycloergometric test exercise.

Though the natural correlation ties were revealed between the cortisol level and indicators of gastric secretion, and they fell on the crucial periods of sports and post-sports ontogenesis.

At rest these ties were positive in the following age categories: among children aged of 7-8, younger teenagers aged of 13-14 and 25-32-year-old wrestlers, who have finished sports career. Correlation coefficients of basal secretion of cortisol/indicators of basal gastric secretion and basal secretion cortisol/indicators of stimulated gastric secretion were in the range from $r = 0.39$ up to $r = 0.80$.

Calculation of correlation coefficients showed that in other age periods the force and the ties orientation changed.

So in the age category - the older teenagers of 15-16 years – the correlation coefficient changed its polarity, and correlation relations were weakened ($r = -0.37$ -- 0.67). Possibly, it is linked with sharp decrease in cortisol concentration more than by 1,5 times in comparison with similar indicators of athletes of the second childhood period and younger teenage age.

In age category - young men and adult athletes – the correlation ties lost reliability.

When researching these indicators after the dosed cycloergometric test exercises we revealed that exercises in general didn't influence the level of manifestation of ACTH concentration. Only the younger young men and athletes who left sport had a reliable decrease in level of cortisol secretion (figure 1, 2).

The positive correlation of average force existing in the conditions of a background between cortisol and indicators of the secretory apparatus of a stomach when performing physical activity changes its polarity and keeps reliable nature only among children of the second childhood period ($r = -0.34$ – -0.77 ; $p < 0.05-0.01$).

Level of aldosterone secretion is practically not regulated by corticotrophin, and substantially determined by receipt of electrolytes in blood and amount of extracellular liquid.

From the data provided in the table we note the coincidence of nature of age dynamics manifestation of aldosterone concentration with the wavy manifestation of glucocorticosteroids level. Yet, this waviness in concentration of an aldosterone has stronger ups and downs in the amplitude.

We observe absolute peaks in age dynamics of aldosterone concentration of athletes-wrestlers in the following age categories: children aged of 7-8 (277.7 ± 24.50 pg/ml) and children aged of 9-10 years (305.5 ± 31.19 pg/ml).

The figure 3 shows the indicators dynamics of aldosterone and cortisol concentration in blood and indicators of basal total proteolytic activity of gastric acid of athletes-wrestlers in the state of muscular rest and after the dosed cycloergometric test exercise.

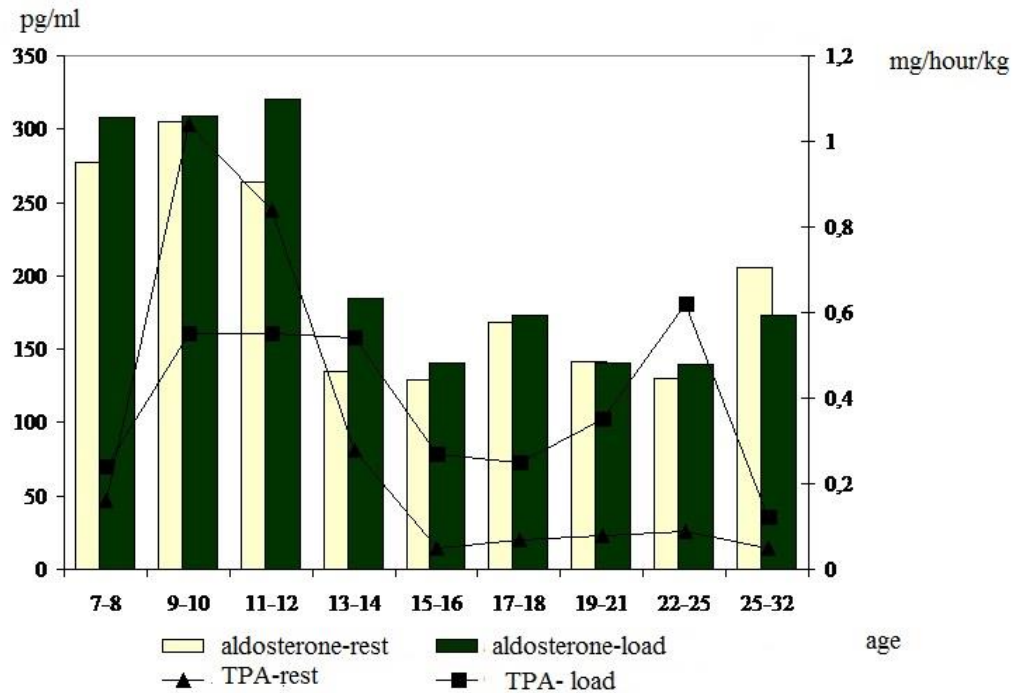


Figure 3. Dynamics of indicators of aldosterone concentration in blood (pg/ml) and the basal total proteolytic activity (TPA) of gastric acid (mg/hour/kg) of wrestlers in the states of rest and after exercises

Note: - reliability of distinctions ($p < 0,05$).

As it appears from the figure 3, in the level of aldosterone concentration we note sharp drop of the age category - younger teenagers (135.0 ± 10.00 pg/ml). Among athletes of the alder teenage age and adult skilled athletes-wrestlers we observe the lowest drop of aldosterone concentration (129.5 ± 18.39 pg/ml and 130.5 ± 11.57 pg/ml respectively).

In age categories - the teenagers, young men, adult athletes and athletes stopped trainings - the aldosterone level falls twice relative to the indicators characteristic for children's age. Despite the received results of athletes-wrestlers in the state of muscular rest, the close positive correlation interrelation between of cortisol and aldosterone indicators is noted.

Coefficients of correlation of athletes of teenage and youthful age are more expressed: $r = 0.78$ and $r = 0.83$ respectively.

Coefficients of correlation of children and highly skilled fighters are less expressed: $r = 0.55$ and $r = 0.52$ respectively.

Correlation relation of the athletes, who stopped trainings, changes the orientation and weakens $r = - 0.49$.

When researching these indicators after the dosed cycloergometric test exercises we revealed that exercises practically don't influence the force and polarity of correlation communications in age groups of children of the period of the second childhood, athletes of teenage and youthful period: $r = 0.45, 0.94, 0.79$ respectively.

But the correlation interrelation of the adult athletes changes polarity ($r = -0.65$), and in the case of the former athletes on the contrary – exercises return correlation coefficient from "-" to "+" and become more expressed in its force ($r = -0.49$; $r = 0.75$ respectively).

The data that we obtained on the presence of correlation coefficient of cortisol / aldosterone throughout all age dynamics and in the state of muscular rest, and after physical activity, surprised us for a little and at the same time gave the chance to assume availability of these ties not only between ACTH and cortisol, but also between ACTH and aldosterone.

We found indeed that children, teenagers, young men and adult athletes have correlation coefficients ACTH /cortisol in the states of rest and respectively they have the following values: 0.34, 0.88, 0.73, 0.47.

Among the athletes stopped trainings, the correlation relation between of ACTH and cortisol indicators is absent.

Children, young men and adult athletes had a destruction of correlation interrelations after accomplishment of physical activity. However, the exercises only reduced force of these relation of the athletes of teenage age from $r = 0.88$ to $r = 0.66$, but increased the narrowness among the former athletes up to $r = 0.72$.

In age categories - adult and former athletes – we did not reveal correlation ties between indicators of ACTH and aldosterone in the states of muscular rest. The athletes of children's, teenage and youthful age repeat a picture on force and polarity of communication, which we observed when considering correlation coefficient of ACTH /cortisol.

We assumed that the dosed cycloergometric test exercises would not have significant effect on aldosterone indicators in general as it was in secretion of a corticotrophin and cortisol. However, contrary to our forecast in the states of exercises, we revealed positive and reliable ties in all age groups of athletes. In particular in the groups of the adult athletes and athletes finished the sports career, rather significant ($p < 0.05$) correlation ties ($r = 0.49$ and 0.63) appeared after exercises performance on the bicycle ergometer. It is possible to assume that the high level of physical activity affected this circumstance.

According to authors of already mentioned above research N.B. Selverova and T.A. Filippova (2000) the coincidence of aldosterone concentration in general with glucocorticosteroids dynamics of the person in the ascending ontogenesis is noted, however the origin of this coincidence isn't explained.

In our opinion the opportunity that in parallel with activation of an axis ACTH - glucocorticosteroids there can appear the activation of an axis of ACTH - mineral corticosteroids isn't excluded. Yet, this is possible only under certain conditions, and in our case these conditions are created by presence of high level of physical activity that is confirmed by our researches.

When considering the schedules, provided in the figure 3, which show dynamics of aldosterone concentration and total indicator of proteolytic activity of natural gastric acid, we note that rises in these indicators fall on the age period of 9-10- and 11-12-year-old of children, and drops of these indicators match between athletes of teenage age and young men of 17-18 years.

The most noted uncoordinated shifts in aldosterone concentration and total indicator of proteolytic activity of natural gastric acid fall on the following age

categories: the children of 7-8 years, adult athletes and athletes who finished the sports career. Coordination of athletes of the older youthful age isn't observed.

When coordinating the shifts at ups and downs between aldosterone concentration and total indicators of proteolytic activity of a secret, we found positive relations, and the coefficient of correlation was in $r=0.58-0.70$ interval.

In case of a mismatch of these shifts at ups and of 7-8-year-old children, the older young men, adult athletes the correlation relationships disappear, and for the former athletes the orientation change from positive to negative ($r=-0.51$).

We assume, that the reason of such manifestation of the obtained data of children aged of 7-8 years consists in the low level of fitness. It is possible to tell that this connection didn't manage to establish.

One of the reasons of disappearance of correlation relations among athletes of the alder youthful age and adult athletes can be the organism dehydration when using various versions of thermal procedures. In particular one of such reasons could be also visiting of pair baths or sauna for weight loss, which results deficit of water in the organism.

Against the background of organism dehydration in case of loss of a significant amount of water there is an oppression of gastric secretion, stimulation mineral corticosteroids and decrease in glucocortosteroid activity. Against the background of 36-hour week training and competitive exercises, in case of deficit of drink such forced weight loss turns into the egregious exercise destroying correlation communications of coefficient of aldosterone / TPA correlation. In particular impact of the stress factor in the form of muscular exercises of a functional condition of digestive tract and corrective effect of training activities on indicators of the secretory apparatus of a stomach and some endocrine shifts in case of a stress are mentioned in the researches of G. Selye (1990), L.N. Smelyshev (2014); C. Jacob, H. Zouhal & J. Prioux (2004); F. Carlsson, R. Persson & B. Karlson (2006).

Finished their sports career athletes wrestlers' amount of physical activity decreases, but the habit to visit a pair bath remains not for weight loss, but as a mean of recovery. In our opinion, under the influence of above-mentioned factors there is a transition to opposite correlation relations.

Thus, this communication negative becomes not only in correlation of aldosterone / TPA ($r=-0.51$) coefficient, but also between aldosterone and separate parameters of gastric secretion: aldosterone / volume of secretion ($r=-0.41$); aldosterone / secretion HCl ($r=-0.56$); aldosterone / pepsinogen ($r=-0.60$).

The exercises offered by us (figure 3) change more age dynamics of a total indicator of proteolytic activity, than dynamics in aldosterone secretion. It reduce the relatively high values of total of proteolytic activity (children of 9-10, 11-12 years); it increase low values (younger and older teenagers and young men and adult athletes); shift in these indicators doesn't occur for children and former athletes.

In prepuberty and for athletes of younger teenage age the increase in aldosterone concentration is observed, and at the age of 13-14- its increase has reliable character.

In other age groups muscular exercises don't lead to reliable changes in aldosterone secretion. Only among athletes of younger teenage age in case of exercises performance on the bicycle ergometer the unidirectional shifts in total proteolytic activity and aldosterone concentration are noted. And the correlation coefficient almost keeps the value at the background level ($r=0.58$ – prior the exercise and $r=0.63$ – after exercise).

Conclusion

As a result of the carried out researches it is revealed that availability of the increased physical activity, which looks as a physiological stressor among the athletes wrestled, generally synchronizes correlation of the secretory interrelations, not only in pituitary-adrenocortical axis system, but also between this system and the secretory apparatus of a stomach.

By materials of our researches it is established that the maximum background peak in secretion of catabolic hormones (corticotrophin hormone and cortisol) is the share of younger youthful age. In the age category of athletes of 22-25 we observe noticeable recession in allocation of ACTH secretion, but cortisol level significantly doesn't change. In our opinion, the received results witness the possibility of transition of the ACTH-cortisol system to other framework of mutual action.

We consider that through cortisol ACTH provides the influence on the secretory apparatus of a stomach. In the age periods matching with the sensitive periods of the ascending and sports ontogenesis (children of 7-8, teenagers and the former athletes), availability of the most close positive background correlation ties between indicators of cortisol and the total proteolytic activity (TPA) of gastric acid is its characteristic feature.

In the age category of the adult athletes-wrestlers and athletes finished the sports career, correlation of interrelations between an ACTH and aldosterone indicator at rest weren't found. At the same time the athletes of children's, teenage and youthful age practically don't differ on force and polarity correlation communications between ACTH and aldosterone indicators at rest from communications between ACTH and cortisol.

Children of 9-10 years, 11-12 years, teenagers and alder young men in case of coincidence of background age of the secretory waves of aldosterone and indicators of the secretory components of gastric acid (both on rises, and on downs) positive correlation communication is noted. The correlation coefficient of aldosterone / TPA fluctuates within 0,58-0,70; $p < 0,05-0,01$. In case of a mismatch of background age of the secretory waves of an aldosterone and indicators of the secretory components of gastric acid, the correlation communication is absent among the athletes of 7-8 years, the older young men and among adult athletes, but it has a negative value on the former athletes.

Generalizing the received results, it is necessary to notice that all above-mentioned manifestations are the product of stable adaptive shifts by means of which there is an impact of physical activity on a functional condition of pituitary-adrenocortical axis system, the secretory apparatus of a stomach and their interrelation.

Also throughout the entire period of sports ontogenesis, the essential adaptive shifts in pituitary-adrenocortical axis system of athletes provided the stability of not only the system, but also a stability of the secretory apparatus of a stomach to the dosed cycloergometric exercises.

According to our data the dosed cycloergometric exercises had no significant effect on adrenocorticotrophic activity of all athletes-wrestlers throughout sports ontogenesis. The exception is a group of younger boys, where physical activity reduced authentically very high background cortisol level, and group of younger teenagers, where exercises authentically increased the aldosterone level.

Among athletes who completed his career (25-32 years), the exercises offered by us also did not cause significant changes in the ACTH and aldosterone secretion, but there was a significant decrease in cortisol secretion.

Throughout all sports and post-sports ontogenesis the secretory apparatus of a stomach of athletes-wrestlers reacted on the impact of the dosed exercises with moderate reliable increase in a total indicator of proteolytic activity. In this reaction were reflected not only traces of "enzymatic memory", but, as possible, also traces of "adaptive memory".

In fact, we revealed almost same answer of pituitary-adrenocortical axis system of athletes of all age groups on the offered exercises. Such reaction of pituitary-adrenocortical axis system of the athletes-wrestlers considerably provided uniformity in reaction of the secretory apparatus of a stomach, which in our research was shown in moderate reliable increase in a total indicator of proteolytic activity in all age groups of athletes fighters.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Sergei F. Panov - doctor of biological sciences, associate professor at the department of sports disciplines, Lipetsk State Pedagogical P. Semenov-Tyan-Shansky University, Lipetsk, Russia.

Irina P. Panova - candidate of pedagogic sciences, associate professor at the department of sports disciplines, Lipetsk State Pedagogical P. Semenov-Tyan-Shansky University, Lipetsk, Russia.

Elena V. Volunskaya - candidate of pedagogic sciences, associate professor at the department of adaptive physical education, physiology and biomedical disciplines, Lipetsk State Pedagogical P. Semenov-Tyan-Shansky University, Lipetsk, Russia.

Andrei V. Chebotarev - candidate of pedagogic sciences, associate professor at the department of sports disciplines, Lipetsk State Pedagogical P. Semenov-Tyan-Shansky University, Lipetsk, Russia.

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