Крючкова Анжелина Илларионовна, младший научный сотрудник, Научно-исследовательская лаборатория биомониторинга, НИИ биологии Днепропетровского национального университета им. Олеся Гончара, пр. Гагарина, 72, г. Днепропетровск, Украина, 49010
E-mail: iwona64@mail.ru
Кульбачко Юрий Люцинович, доцент, кандидат биологических наук, кафедра зоологии и экологии, Днепропетровский национальный университет им. Олеся Гончара, пр. Гагарина, 72, г. Днепропетровск, Украина, 49010
E-mail: iwona64@mail.ru

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STRUCTURE OF SKELETAL MUSCLES AFTER HYPOKINESIA AND PHYSICAL LOADING OF MIDDLE AEROBIC POWER

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In the article is shown that determined degree of destructive changes in skeletal muscles is in direct dependence on the term of hypokinesia limitation. Application of kinesiotherapy intensifies the repair processes and substantially reduces the terms of renewal of structurally-functional properties of skeletal muscles after hypokinesia.
Keywords: hypokinesia, skeletal muscle, degeneration, physical load, regeneration, rat.

У статті показано, що встановлений ступінь деструктивних змін в скелетних м'язах знаходиться в прямій залежності від терміну обмеження рухової активності. Застосування кінезіотерапії підсилює процеси репарації та істотно скорочує термін відновлення структурно-функціональних властивостей скелетних м'язів після гіпокінезії.
Ключові слова: гіпокінезія, скелетні м'язи, дегенерація, фізичне навантаження, регенерація, щур.

1. Introduction

Dystrophic and the atrophic processes in the skeletal muscles of various genesis rather often arise up on bedrock of previous of long duration hypokinesia, which by life conditions, character of work, age, various diseases, immobilization of various parts of a man body after the traumas of a locomotorium and so forth [1, 2]. It is known that in conditions of hypokinesia not only metabolism of muscles varies [3–6], but also their structure changes [5, 7, 12]. Search of factors which strengthen the reparative regeneration and renewal of function of muscular fibers after hypokinesia allowed to set positive influence on these processes of the dosed physical loading [5, 8]. Taking into account his powerful stimulant influence on various organs and fabrics of human organism [6, 7], we put by a purpose our research to learn character of structural alteration of skeletal muscles, which arises up under act of the dosed physical loading of middle aerobic power after of long duration hypokinesia [8].

2. Raising of problemy

It is necessary to study the structural changes of muscle fibers and microcirculation network at the physical loading after of long duration hypokinesia.

3. Review of literature

Researches difficulties of influence of protracted hypokinesia on the organism of man are related to the row of objective and subjective reasons [1, 2, 11]. They determine violation of basic methodological principle in obedience to which functional ansabel of lokomotory organization of organism must be examined as integral system of intercommunications of its component components [10]. Above all things it touches the estimation of such intercommunications between muscle fibers and blood vessels [10–12]. Functional integrity of these components is confirmed by the results of research of muscles pathology after protracted hypokinesia, where most authors specify on the expressed changes of ultrastructural vehicle of nervous fibres [9]. However, works devoted to influence of protracted hypokinesia on the organism of different animals and man pay not enough attention to research of posthypokinetic reactions in muscle fibers and wall of blood vessels is spared undeservedly [1, 3, 11, 12]. Less researches are conducted on the problem of estimation of influence of the physical loading of a different intensity on these components after protracted hypokinesia [8].

4. Materials and methods

Researches are conducted on 60 adult not thoroughbred (1 annual) rats-males. Limitation of motive activity on the method [9] offered by us, term of hypokinesia 300 days. The physical loadings were designed in tredmile (daily trainings during 15 minutes at speed at run 20 m/min during 30 days). Taking away of material during experimental hypokinesia was conducted on 7, 180 and 300 days. After the dosed physical loading animals were destroyed from the experiment in obedience to Rules of humane conduct with laboratory animals (by overdosing of ether anesthesia). Material for histological and electronic microscopic research was prepared on the generally accepted method.

5. Results of research and their discussion

Already on 7 days after development of hypokinesia in endo- and perimysium there are the phenomena of intensive edema, expressed prolipheration cellular reaction in fabrics which surround vascular-nervous bunches. It is accompanied by the increase at a 1,5 one by volume fate of stromal components (Fig. 1).

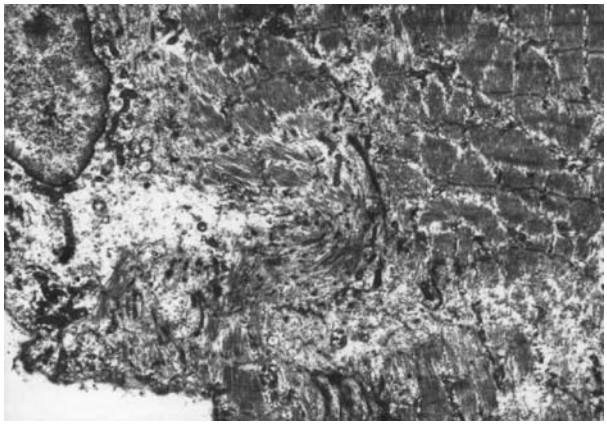

Fig. 1. Destruction near-by nuclear sarcoplasmatics raethyculum of as and result of lysis of myofibrilar vehicle in and FOG-fiber to the muscle soleus after on 7 day's of hypokinesia. Magn.: x 5000

Has sarcoplasm most muscular fibers low electron-optical density, contains the promoted amount of vacuoles, the transversal striped is lost, kernels are localized near-by central part of fiber. Such phenomenon is unspecific and meets at some myopathies [10], and also as compensative adaptive reaction of muscular fiber to metabolism in anaerobic terms [6].

It is known that an ischemic compression syndrome [2, 8] develops in the conditions of hypokinesia, narrowing of road clearance of bloodvessels, delay of products of exchange and delivery of oxygen passes as a result, that conduces to tissue hypoxia.

Tissue hypoxia, in the turn, is the reason of local hydratation cellular and noncellular components. It is set at the analysis of electronic photomicrographs, that in 180 days of hypokinesia the phenomena of intracellular edema, which conduce to delamination of miofiber, grow in muscular fibers. Formation of mielinlooking parts and vacuolization of a sarcoplasm is the typical phenomenon. It is multiplied mitochondrions in sizes, their matrix has a low electronoptic density, crests disoriented, shortened, fragmented (Fig. 2).

The such structural changes are the reason of diminishment of active working surface of mitochondrions and create pre-conditions for the origin of the ATF deficit. The cisterns of sarcoplasmic net and the Goldgy complex are extended, that testifies to activating of synthetic processes on membranes these organels. Lizosomes is concentrated mainly in the areas of destruction of miophibrils. There is the promoted amount of including of various electronoptical of density in sarcoplasmic (Fig. 3).

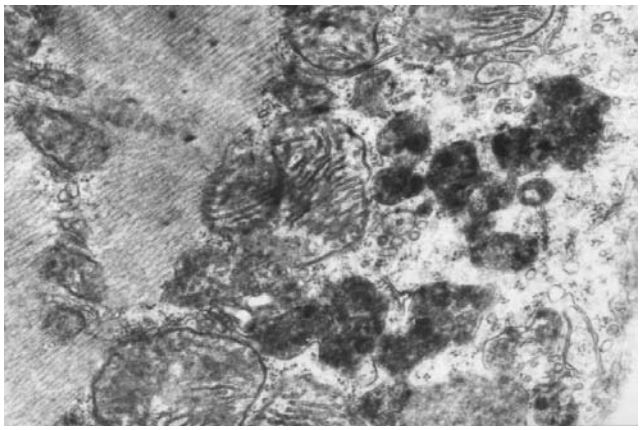

Fig. 2. Formations of lamelar little bodies and lipid to including at the sarcoplasma FG- muscular fiber of muscle soleus after 180 day's hypokynesia: 1 – myonuclear; 2 – lamelar little body; 3 – lipid including. Magn.: x 12000

Fig. 3. Multiplied mitochondrions in sizes, their matrix has a low electronoptic density, crests disoriented, shortened, fragmented of muscle soleus after 180 day's hypokynesia. Magn.: x 12000

There is diminishment of edema and increase of specific fate of stromal component of muscles in 300 days of hypokinesia. Thus the promoted amount of macrophages, lipoblasts and fibroblasts with the proper increase of number of collagenic and silverness fibers which lie on as large bunches parallel longitudinal axis of blood vessels appears in connective tissue framework of muscles. For most muscular fibers the characteristic dystrophic-atrophy and necrotic phenomena.

Muscular fibers are refined, is lost transversal striped, the local bulges are sometimes formed. It is thus needed to mark that intensity of defeat in a greater measure is shown in oxidizing-glicolitic fibers. This phenomenon it is possible to explain by diminishment of expressed of compression syndrome, that is instrumental in expansion of blood vessels and strengthening of their drainage function. As a result of this pH environment changes in an alkaline side. It is known that oxidizing-glicolitic fibers collapse more intensive in an alkaline environment [7, 9]. At electronic-microscopic research in this period of experiment in the muscular fibers of hearth the defeats carry diffuse character. Muscular fibers diminish in a diameter, quite often there are the

phenomena of their lysis. In such areas is multiplied the amount of autofogosoms and remaining little bodies. The kernels of muscular fibers have uneven contours, clarified nucleoplasm and border chromatin. Mitochondrions with clarified matrix, fragmented and sharply reduse crests, sometimes there is destruction of external membrane, that conduces to diminishment of the SDG activity in rapid oxidizing-glicolitic fibers (Fig. 4).

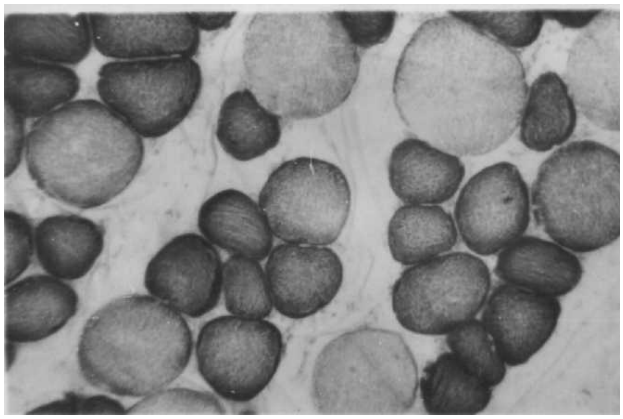

Fig. 4. Activity of ferments reaction on SDG in the muscular fibers of different types through 300 day's hypokynesia. Serial transversal cuts of muscle soleus: 1 – FOG muscular fiber; 2 – FG muscular fiber; 3 – SO muscular fiber; 4 – defermentive muscular fiber. Magn.: x 600

The physical loading after 300 day's hypokinesia gives the expressed and rapid recreational effect. In short space (15 days) the initial amount of locuses destruction of muscular fabric goes down considerably. The degree of expressed of this destruction changes also: necrotic areas do not meet practically, there are the only refined, winded, without transversal and longitudinal striped of fiber. As compared to the results of I-series researches the phenomena of edema are shown in a less measure. There is the insignificant increase of amount of connecting tissue elements. However, foregoing processes take place on the limited areas of transversal to the cut of muscular fabric, does not have a tendency to generalization and will be liquidated in the first 10–15 days after the physical loading of middle intensity.

At the increase of multiple of action of the physical loading (16–30 days) the far of the fatty including appears in sarcoplasm, the channels of sarcoplazmatic net are extended. Pays on itself attention of increase of absolute number of capillaries, which is on an area 1 мм^2 transversal to the cut to the muscle (Fig. 5).

At the same time, beginning from the end of the first week, is multiplied the area of the mutual ceiling of areas of blood suplly between next gemovessels. Microrelief of luminative surface is smoothed out in endotheliocytes, an amount and diameter of micropinotic of vacuoles rises.

All of it represents close character of mutual alteration of blood vessels net work and component components of muscles under act of the promoted motive activity.

Fig. 5. Edema of cytoplasm of endotheliocytes of the hemocapillar muscle soleus to the muscle on 20 time of period of rehabilitation at the increase of multiple of the physical loading of middle aerobic power: 1 – muscular fiber; 2 – cytoplasm of endotheliocytes cages; 3– are sprouts of fibroblasts. Magn.: x 8000

Consequently, speed-up renewal of muscular fabric under act of the physical loading testifies to stimulation of metabolic processes which will be realized through strengthening of function of intracelullar organels, which provide a muscular fiber by energy and plastic material. More powerful regenerative effect which is observed at complex action of the physical loading of middle aerobic power it is possible to explain by influencing of active mechanical stretch of the dystrophic changed muscular fibers, on a background the activated circulation of blood in muscles during at run, that supports at them metabolic processes at more high level, than only at exceptional application of pharmacological preparations.

The thus dosed physical loading of aerobic character strengthens the reparative regeneration of muscular fibers after of long duration hypokinesia.

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Popel' Serg, associate professor, Department of theory and method of physical culture and sport, Precarpatian national university named after Vasyl Stefanyk, Shevchenka st, 57, Ivano-Frankivsk, Ukraine, 76025
E-mail: serg_popel@mail.ru
Duma Zenoviy, professor, Department physical rehabilitation, Precarpatian national university named after Vasyl Stefanyk , Shevchenka str, 57, Ivano-Frankivsk, Ukraine, 76025

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ХРОНОБІОЛОГІЧНИЙ ПАСПОРТ ЯК ЗАСІБ ОПТИМІЗАЦІЇ РЕЖИМУ ДНЯ СТУДЕНТІВ КЛАСИЧНОГО УНІВЕРСИТЕТУ

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Однією з причин погіршення стану здоров'я молоді є розузгодження внутрішніх біоритмів та базових циклів «праці та відпочинку», «сну та пильнування» та режиму харчування. Питання профілактики десинхронозу у студентів полягає у плануванні та оптимізації розпорядку дня з урахуванням біоритмологічного типу людини. Хронобіологічний паспорт є системою моніторування здоров'я студентів з використанням хронобіологічного підходу.
Ключові слова: *десинхроноз, адаптація, хронобіологічний тип, хронобіологічний підхід, хронобіологічний паспорт, ритмофільний тип.*