TACTILE STIMULATION PECULIARITIES DURING DIFFERENT FUNCTIONAL STATUS OF THE BODY

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***Abstract**: tactile stimulation as one of the methods of physical therapy is widely used in sports medicine during integrated treatment and rehabilitation process. That is why the study of peculiarities of tactile stimulation and tactile sensations under action of different stimuli during different functional status of the body is of great scientific interest.*
The response reaction of the organism on receptor apparatus stimulation (irritation) under action of different stimuli depends on anatomic and physiological features of receptor system, on physical and chemical changes occurring at this time, on characteristics of acting stimulus and on functional status of the body.
Dependence of tactile sensations on characteristics of acting stimulus is clearly observed under action of ultrasonic stimuli, widely used in physiotherapy.
Different tactile sensations depend on stimulation characteristics, and their relation with environmental characteristics.
In the state of satiation, compared to starvation, during tactile stimulation of different skin zones such parameters of galvanic-skin reaction, as amplitude and duration, are usually reduced. Such reaction may be explained by development of extended inhibition in cerebral cortex, by emergence of slow high-voltage activity, predisposition to sleeping and by reduction of emotiogenic structure activity in case of satiation.
All the above-mentioned factors have to be taken into account at clinical trials during action of different irritating stimuli on human body and when carrying out physiotherapeutic procedures.
***Keywords**: tactile stimulation, starvation, satiation, receptors, galvanic-skin reaction.*

ОСОБЕННОСТИ ТАКТИЛЬНОГО РАЗДРАЖЕНИЯ ПРИ РАЗЛИЧНЫХ ФУНКЦИОНАЛЬНЫХ СОСТОЯНИЯХ ОРГАНИЗМА

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Аннотация: *тактильное раздражение, как один из методов физической терапии, широко применяется в спортивной медицине при комплексном лечении, в процессе реабилитации. Поэтому изучение особенностей тактильного раздражения и тактильных ощущений во время действия различных стимулов при различных функциональных состояниях организма представляет большой научный интерес.*

Ответная реакция организма на раздражение рецепторного аппарата при действии различных стимулов зависит от анатомо-физиологических особенностей рецепторной системы, происходящих при этом физико-химических изменений, характеристик действующего стимула и от функционального состояния организма.

Зависимость тактильных ощущений от характеристик воздействующего стимула наглядно прослеживается при действии ультразвуковых стимулов, широко применяемых в физиотерапии.

Разные тактильные ощущения зависят от характеристик стимуляции, их соотношения с характеристиками окружающей среды.

В состоянии насыщения, по сравнению с голодом, при тактильном раздражении различных зон кожи такие параметры кожно-гальванической реакции, как амплитуда и продолжительность, уменьшены. Такая реакция объясняется развитием при насыщении разлитого торможения в коре головного мозга, появлением медленной высоковольтной активности, предраспо-ложенностью ко сну, понижением активности эмоциогенных структур.

Вышеуказанное необходимо учесть при клинических исследованиях во время действия различных раздражающих стимулов на организм человека, при проведении физиотерапевтических процедур.

Ключевые слова: *тактильное раздражение, голод, насыщение, рецепторы, кожно-гальваническая реакция.*

Tactile stimulation as one of the methods of physical therapy is widely used in medicine and, in particular, during rehabilitation period. That is why, the study of tactile stimulations and tactile sensations under action of different stimuli during different functional status of the body is of great scientific interest.

Receptors are specialized structures of the biological object, which give signals on changes both in the internal area and external area of the organism.

Structural diversity of receptors is a wide area for scientific research of their structural and functional compatibility and of exploration of actual reason of such diversity. The problem statement lies in determination of specific sensory function, in perception of stimulants of different modality, especially the irritators of such sensory system, as skin sensibility system is.

Receptor surfaces of some sensory organs may be stimulated by different kinds of energy. For example, tactile receptors, vestibular receptors and pain receptors under definite conditions may react on sounds and vibrations of significant intensity. But no one of the above-mentioned receptors can be compared to acoustic organ according to degree of sensibility to the exposure of small acoustic energies and to amount of information obtained this way.

One or another sensory system may be considered as specialized one regarding perception of definite kind of energy only if just one kind of energy among all available ones becomes the most effective for the given system both by opportunity of exposure of small amounts of this energy and by the amount of received information.

Thus, the specialized sensory systems have to be as sensitive as possible to some kind of signals incoming from outside. At the same time, it is necessary to keep in the specialized sensory systems as much energy structure details as possible, which correspond to acting signal. These two necessary requirements to the sensory specificity are fulfilled by different structural and functional ways discovered in the different sensory systems [2, 22, 23].

Stimulation of human organism receptors through exposure of different factors plays an important role in visceral functions control [5, 7, 9-11].

At the same time, the organism response depends both on characteristics of acting factors and on the functional status of the organism itself [3, 4, 6-8, 24].

Ultrasound, laser radiation and ultraviolet rays find wide application in medicine for curative purposes [12-20].

Let’s discuss the current literature data on tactile reactions caused by ultrasonic stimuli.

Ultrasonic exposure induces a wide range of sensations in human. The above-mentioned sensations are related to the activation of peripheral apparatus of the somatosensory system. Activation of the somatosensory system results in development of tactile and pain senses, as well as senses of vibration, warmth, cold and itch.

Electrophysiological methods provide answers regarding focused ultrasound action on mollusk equilibrium receptor apparatus, on fish electroreceptor system and frog acoustic system.

If we coincide the ultrasound radiator focal area center with human skin tender points, then we can induce tactile sensations by the ultrasound exposure. Depending on stimuli intensity and duration, human characterizes sensations as a light touch, like a touch of little brush, as a local tap (dap), as a water dripping etc.

It is known that skin sensitivity has a discrete nature, i.e. there are sensitive (tender) and insensitive, so-called “blind” spots. Action of non-destructive stimuli on “blind” spots causes no sensations. Only in case of tissue ablation a pain appears in the area, size of which is substantially wider than the impact point. Diameter of some sensitive spots may be very small, and due to this fact, they are called sensitive (tender) points. In simple words, the tender points of wrist skin occupy almost the entire surface, while at forearm and shoulder their density is smaller. Sensations of ultrasound exposure appear only when a focal area coincides with a sensitive point. In the neighbor “blind” points, where there are no receptor structures, ultrasound induces no sensations, except for extended pain, which appears in case of certain mode of exposure.

When focused ultrasonic stimuli with roughly 25 msec duration are used, a single tactile sensation is appeared. In case of longer duration two sensations appear, which correspond to stimulation start and finish.

When ultrasound frequencies are within 0,47-2,67 MHz range, the value of sensitivity limit depends not on ultrasound frequency, but on the amplitude of medium dislocation in the focal area. As soon as the necessary value of the order of 0.05-0,1mkm is reached, a tactile sensation appears in the area of influence. It should be noted that vibrational redistribution of the area particles occurs due to ultrasound stimuli, while in case of their prolongation two sensations appear, which denote stimulation start and finish. Thus, sensations correspond with leading and trailing edges of stimulus [1, 2, 17].

Based on the sensory organs' physiology, the response threshold in the optimum frequency area is smallest, while intensity range and resolution ability are highest [22, 23].

In the considered case, it is not an ultrasound frequency, but ultrasonic stimulus displacement frequency, during which a tactile sensation threshold is smallest. This frequency equals to 250 Hz for tactile reception. If stimuli frequently follow each other, then tactile sensation threshold increases, and if displacement frequency is more than 700 impulses per min, then tactile sensations are not induced [1, 2, 13, 17].

Such regularity is observed not only for ultrasonic stimuli, but also for any rhythmic mechanical impact on a skin. Tactile threshold is not related to ultrasound frequency: a physiological threshold of skin receptor structure action is roughly 700 Hz, while ultrasound frequency is by three order higher.

When a focal area dislocates on arm skin from fingers to forearm, a tactile sensation threshold gradually increases. Since the receptor structure density reduces from fingers to forearm, so the increase in tactile sensation threshold is understandable.

Change in tactile sensations threshold to a certain extent is related to tactile receptor structure. For example, tactile thresholds of back sides of hand and forearm is higher than those of palm of the hand. Receptor apparatus of back side is related to villi, which are not available at palm of the hand. It is still unknown is there any difference in density of arm skin receptor structures distribution at palm and dorsum. That is why the ratio between tactile receptor structure construction and function of these two areas of skin is not ultimately established.

Let's consider the action of visceral organs and skin receptors stimulation on functional status of organism and the results obtained by us.

It is established that gastrointestinal tract receptors stimulation through mechanical extension of thin-walled rubber bag of stomach and bowel walls or when taking food in large amounts causes secretory and motional processes suppression in the gastrointestinal tract and suppression of motor activity of humans and animals [3, 4].

Satiation has a clearly defined impact on emotional state of human. We have studied galvanic-skin reaction (I.R. Tarkhanov's phenomenon), which is expressed in potential change between two skin surface areas under exposure of different irritants, which cause emotional excitement and reflect the state of human and animal vegetative nervous system and emotional-affect sphere and at the same time represent permanent component part of orientation-explorative action.

Our research showed that a curve reflecting galvanic-skin reaction has lower amplitude and is less prolonged during tactile stimulation of neck skin (touch of soft brush) in state of satiation, than it was in the fasted state. The same outcome was observed during tactile stimulation of lip area. Reduction of galvanic-skin reaction amplitude and duration was observed during exposure of photic stimulus and when performing physical work, as well.

In the state of satiation an extended inhibition emerges that is confirmed by origination of slow high-voltage activity in cerebral cortex, predisposition to sleep and by reduction of emotiogenic structure activity (decrease of galvanic-skin reaction amplitude and duration) [24].

Response and sensations induced by tactile stimulation substantially depend not only on the central nervous system state, but on the characteristics of irritating stimulus.

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