INFLUENCE OF SPINAL MICROPOLARIZATION ON THE NEURONAL AND CONDUCTIVE SYSTEMS OF SPINAL CORD

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Abstract - *Spinal micropolarization was carried out in 43 patients with different impairments of spinal functions. The electrophysiological examining (surface and stimulated EMG of leg muscles and elecromyelogramm recorded by electrodes implanted at level L1-5) was performed before and at the 20-30-th min of micropolarization. The subthreshold border excitability decreasing, presynaptic inhibition increasing, fusimotor system activation decreasing, H-reflex depression appearance after low-frequency stimulation were noticed in spastic patients. High-frequency diapason mode increasing and increasing of early components of motor cortex SSEP supposed to be the result of the activation of conductive system. The increasing of mode of both low-frequency and high-frequency electromyelogramm diapasons was observed in weak paresis.. More stable H-reflex appearance, increasing of M-response amplitude, increasing of excitability of peripheral nerves and muscle tonicity in rest, voluntary EMG appearance were observed. So, direct current influence on lumbar level leads to specific changes of the neural and conductive systems state.*

Keywords: micropolarization, spinal cord, motor disorders, electromyelogramm, electromyogramm

1. Introduction

Earlier we showed the improvement of moving and vegetative functions in the patients with spondylitis tuberculosa and spinal cord trauma after using the spinal micropolarization (6). However, for the further improving of the method, it is necessary to know more about the reaction of the different mechanisms of CNS during the micropolarization influence.

2. Methods

43 patients with the impairment of spinal function of different genesis (spinal cord trauma, myelodysplasia, cerebral palsy) got the medical spinal micropolarization by the skin electrodes (the area 400-600 sq.mm) with the help of the standard devices for the galvanization. The electrodes were put along the spinal column at the level of Th10-11 - L1-2. In case of the spastic forms the anode was located in rostral position, the cathode in caudal one, in case of the weak forms - vice versa. The average current power was 600 mcA. The time of the procedure was 30-45 minutes. The treatment course included 10-15 procedures.

Before the procedure and at the 20-30th minute of the micropolarization the spinal cord reflex excitability was estimated with using of recording of H- and M-responses of m.soleus. We constructed the recovery curve of H-reflex (only for spastic forms), recorded the EMG of the lower extremities' muscles during voluntary movement, estimated objectively a muscle tonicity (by the equipment which was specially worked out) in rest and in voluntary contraction. In the weak forms, in some cases we used an extra estimation of the n.tibialis excitability by the constructing of the curve "power - continuance". 15 patients (8 persons with spastic forms, 7 with weak ones) had epidural implanted electrodes at the level of L1-5 segments for the following spinal cord treating electrostimulation. It gave the opportunity to record the spinal electromyelogramm. In several patients we also recorded SSEP of the cortical motor zone on the n.medianus stimulation.

3. Results

It was observed, that the patients with spastic forms had got the reduction of the subthreshold border excitability, increasing of presynaptic inhibition, reduction of muscle spindle system's activation.

The depression of H-reflex, which appeared when the low-frequency stimulation (3 Hz) was made also showed the increasing of the presynaptic inhibition. The reduction of the motorneural apparatus excitability was followed by the reduction of mode of a low-frequency diapason of the electromyelogramm (10-25 Hz). The high-frequency mode (more than 30 Hz) rose. It assumes the activation of the conductive system, that is proved by the increasing amplitude of the early components of SSEP of motor cortex. The alterations in functional status of the spinal cord and brain neuronal systems often led to the increasing of the agonist's EMG amplitude. In this case the "likespike" EMG configuration could turn into an interferentional one.

All the alterations mentioned above led to an significant reduction of the muscle tonicity. The enhancement of the differences between the muscle tonicity in rest condition and in voluntary contraction pointed out to the increasing of the muscle contractability.

In case of a weak paresis the mode increasing both of low-frequency and high-frequency diapasons of electromyeloramm was observed. It correspondingly denotes the activation of the spinal cord's neural and conductive systems (5). In several cases it was observed the more stable appearance of the H-reflex, enhancement of the M-response amplitude, increasing of the excitability of peripherical nerves and muscle tonicity in rest. It is important to underline that even during the first procedure the EMG during voluntary movement which was absent before the micropolarization, could appear.

4. Discussion

So, the transcutaneous spinal micropolarization of the lumbar segments of the patients with the spinal cord functions' impairments leads to the alterations of different spinal mechanisms. First of all, these alterations depend on the peculiarities of direct current's influense on the neural tissue (one of the peculiarities is the possibility to prevent the development of the parabiotic process, as it is known that the direct current is the best physical agent for this aim), it was proved earlier by the different experimental researches. Thus, for example, it was shown the reduction of spinal cord's monosynaptic reflexes of animals in the case of anode location on the dorsal surface of spinal cord and the cathode - on the ventral root, and the increase of reflex responses in the case of the opposite location of the polarizating electrodes (7). It is to be noted that the reduction of the spinal neurons reflex excitability could be also observed when the electrodes were located along the spinal column and the descending current (anode - in rostral position, cathode - in caudal one) was passing through. In case of the ascenting current the excitability increased (3).

The mechanism of these spinal cord's reflex activity alterations were studied in the set of experiments which was carried out by J.Eccles, P.Kostiuk, R.Schmidt (8). During their experiments it was shown that these effects of direct current are caused by changing of the membrane potential.

Recently, in different researches (10, 12) it was shown a possibility of using of the direct current through the implanted electrodes for the regeneration of the damaged spinal cord's conductive systems and peripherical nerves in the animals. On the other hand, there are works (11), which denote the necessity of being careful during the influence by the direct current through the implanted electrodes, because firstly, there is a difficulty in the definition of the permissible current parameters which don't cause the damage of the neural tissue, and secondly, the implantation of the electrode itself, its physical influence can cause the demyelinizating process. The transcutaneous spinal micropolarization has no such kinds of defects. It successfully combines the simplicity and uninvasivness of the traditional physiotherapeutic procedures (different variants of galvanization), with a rather high selectivity of the influence. A high selectivity compared with stimulation through implanted electrodes is achieved by the using of the small area electrodes.

We consider this method might be used not only as an independent treating procedure, but as an optimizing one, e.g., as it was shown before, together with the epidural electrostimulation (6), functional biocontrol with biofeedback (1) etc. Experimental researches which also showed the opportunity of the neural circuits organization (4), construction of the neural architecture (9), the alterations in the biochemical processes under the influence of a direct current, makes us to consider this method perspective at the treatment of motor disorders of different genesis (1).

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