FUNCTIONAL CHANGES IN THE PERIPHERAL MOTOR APPARATUS OF THE HUMAN ASSOCIATED WITH THE PAIN SYNDROME

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Changes that occur in the organism in connection with the action of nociceptive stimuli are one of the intrinsic characteristics of a pathological process. However, up until now they have not been adequately studied. Changes in the central nervous system related to pain are reflected most directly in the state of the peripheral motor apparatus. The literature contains evidence that pain may accompany an elevation in the tonus of certain muscle groups [1, 9], so called algic or reflex contractures [3, 4], as well as diffuse, subordinate or adaptive-trophic changes in the neuromuscular units.

The purpose of this work was to investigate the functional changes in the motor apparatus associated with pain, and not demonstrated by the usual clinical observations.

EXPERIMENTAL METHOD

In this project we used two procedures: 1) electromyographic investigation of the activity of muscles related, in their innervation, to the focus of pain impulsion, and 2) investigation of the subordinate changes in the excitability of muscles not linked with the site of the pain.

Three groups of patients underwent the electromyographic investigation: 1) patients with lumbar pains (mainly secondary lumbosacral radiculitis); 2) patients with joint pains (in the majority of cases, polyarthritis); 3) patients with headaches (sequelae of cerebral arachnoiditis and residual symptoms of tubercular meningitis). Control investigations were carried out on healthy, adult individuals. In each case, we studied the electrical activity of those muscles which were most closely related to the focus of the pain impulsion in their innervation, namely the sacrospinalis muscles in the case of lumbar pain, the muscle antagonists of the painful joint in the case of extremity joint pains, and the occipital, frontal, and trapezius muscles in the case of headaches.

The electrical activity of these muscles was studied at various positions of the body, using all poses which, under normal conditions, are not accompanied by activity of these muscles. Specifically: the electromyogram of the sacrospinalis muscles was recorded with flexion of the torso in the standing position, of the antagonist muscles of a painful joint, with slight, active shift in the position of the extremity; and of the head and neck muscles, with no facial expression or masticatory movement in the lying and standing position and with the head and torso bent.

The muscle potentials were conducted by superficial electrodes (100 microvolt amplification, corresponding to 18 mm) and recorded on a loop oscillograph.

EXPERIMENTAL RESULTS

The activity of the sacrospinalis muscles was investigated in 41 patients complaining of lumbar pain, and in 13 healthy subjects.

The bioelectric activity of these muscles was recorded in the standing position both in the patients and in most of the healthy individuals. Marked differences appeared in the electromyogram of the patients and healthy subjects when they held the position with flexion of the torso. In this pose, there was no electrical activity of the sacrospinalis muscles in 12 out of the 14 healthy people (Fig. 1a). Out of the 41 patients, in the flexed pose, 36 showed
electrical activity of the sacrospinalis muscles. Thus, with lumbar pains we observed an inversion of the coordination relationships during movement of the vertebral column: with flexion of the vertebral column, there was either the appearance, or the strengthening, of activity in the extensors of the vertebral column. Electrical activity of the sacrospinalis muscles in the flexed torso position was absent in only 5 patients, and in those cases, they did not complain of pain at the time of the investigation.

![Fig. 1. Electric activity of the sacrospinalis muscles with flexion of the torso. a) In healthy woman D.; b) in patient C.; c) in patient P. Meaning of the curves (from above downward): electromyogram of the right sacrospinalis muscle; electromyogram of the left sacrospinalis muscle; zero line; time markings (0.1 second).](image)

In the patients with lumbar pains, certain characteristics in the electromyogram of the sacrospinalis muscles were noted in a number of cases, which were absent during voluntary action of these muscles in the healthy subjects; in particular, their activity sometimes appeared like needle-shaped bursts of the fasciculation type against the background of normal, asynchronous activity of lower amplitude (Fig. 1b); not infrequently the activity appeared in volleys, i.e., involved alternation of groups of impulses with periods of bioelectric inactivity (Fig. 1c); in a number of the cases it was possible to distinguish wavelike fluctuations in the amplitude of the impulses, at a rhythm of 3-6 fluctuations per second (see lower curve in Fig. 1b).

The electromyographical investigation of the muscles functionally related to the painful joints (18 patients and 9 healthy subjects) demonstrated that in many patients the muscle antagonist manifests electrical activity even with slight shifts of the pose which are normally not accompanied by this activity. Instruction to increase the movement resulted, in a number of the patients, in intensification of the activity within the antagonist; in this case, the antagonist's electrical activity was usually diminished. We often noted characteristics in the electromyogram that were analogous to those described in association with the lumbar pains.

Electromyographic investigation of the occipital, frontal and trapezius muscles in 25 patients who had suffered cerebral arachnoiditis, and in 23 patients with residual symptoms of tubercular meningitis, showed the electrical activity of these muscles to be quiet in the majority of patients (34 of 88) that complained of headaches during the investigation (Fig. 2b, c and d). There was no bioelectric activity with these muscles at rest in any of the healthy subjects (Fig. 2a), nor in 7 of the 10 patients that did not complain of headache during the investigation. We often observed a definite parallel relationship between the intensity of the headache and the magnitude of the investigated muscles' electrical activity. Thus, with increase in the pain related to flexion of the head, the amplitude of the bio-currents in the electromyogram of the occipital or frontal muscles was seen to increase (see Fig. 2b). Also, if during an attack of headaches there was electrical activity in the occipital muscle, then several days after cessation of the attack the electrical activity of this muscle disappeared (see Fig. 2c).