

SOME FEATURES OF THE STRETCH REFLEX AFTER SPINAL CORD INJURY

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The object of the investigation was to study correlation between the state of the spinal reflex apparatus in spinal patients and the presence or absence of clonus. The magnitude of the electrical response of the soleus muscle to passive dorsiflexion of the angle at different speeds was studied. Clonus took place in 10 patients (group 1) and was absent in another 12 patients (group 2). Ten healthy subjects served as the control group. A considerable difference was found in the curves of distribution of magnitude of the responses for the different groups of subjects. Characteristically the patients of group 1 showed a shift of the model to the right, but the patients of group 2 showed a shift to the left compared with the mode to healthy subjects. The same pattern was found regardless of the angular velocity studied. The threshold velocity in the patients of group 2 was significantly higher than normal, whereas in the patients of group 1 it was close to normal. Activity in the calf muscles and ability to move about or even to walk were observed in most patients of group 1 but in only a few patients of group 2. It is suggested that the presence of clonus corresponds to a more normal state of the spinal reflex apparatus and to better clinical indices than in patients without clonus.

KEY WORDS: spinal cord injury; stretch reflex; clonus; gamma-system.

Investigation of the stretch reflex in patients with injury to the spine and spinal cord can be used to study the state of spinal mechanisms. In some cases during passive dorsiflexion of the ankle or in response to a tap on the Achilles' tendon the patients develop repetitive oscillatory movements of the foot, or clonus. The severity of the clonic oscillations and their duration vary in individual patients, but their stability is a characteristic feature. Clonus does not disappear despite prolonged remedial gymnastics or massage, although it does not increase in severity during inactivity.

The origin of clonus is attributed to a disturbance of the pyramidal tract [1], but it can also be produced experimentally in healthy subjects [2]. Some workers attribute this phenomenon to the presence of a pacemaker in the spinal cord [4], whereas others consider that a disturbance of supraspinal control and increased excitability of spinal cord structures are responsible for the development of clonus [2].

It has been concluded from an investigation of afferent impulsion from muscle spindles in healthy subjects and spastic patients [3] that an important role in the genesis of the clonus which develops after contraction of muscles is played by activation of the spindles in the relaxation phase, potentiated by a raised background level of the gamma-system.

The object of this investigation was to study clonus in patients with spinal cord injury in order to determine correlation between it and the state of the spinal reflex system.

EXPERIMENTAL METHOD

Altogether 22 patients with trauma at different levels and of different severity and also with different degrees of recovery of functions were studied. The time elapsing after injury varied from 1 to 12 years in these patients. Clonus was observed in 10 patients (group 1) but it was absent in the other 12 patients (group 2). Each group included patients with injury at different levels and of different degrees of severity. As the control, similar tests were carried out on 10 healthy subjects. These tests were as follows: With the patient lying on his

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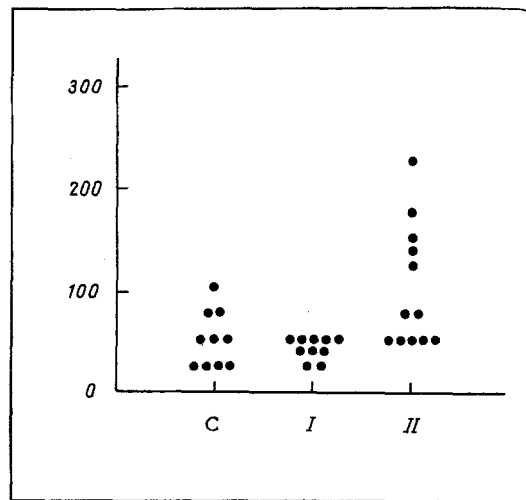


Fig. 1. Threshold velocity of responses. Abscissa, C) control, I) patients of group 1, II) patients of group 2; ordinate, angular velocity (in deg/sec).

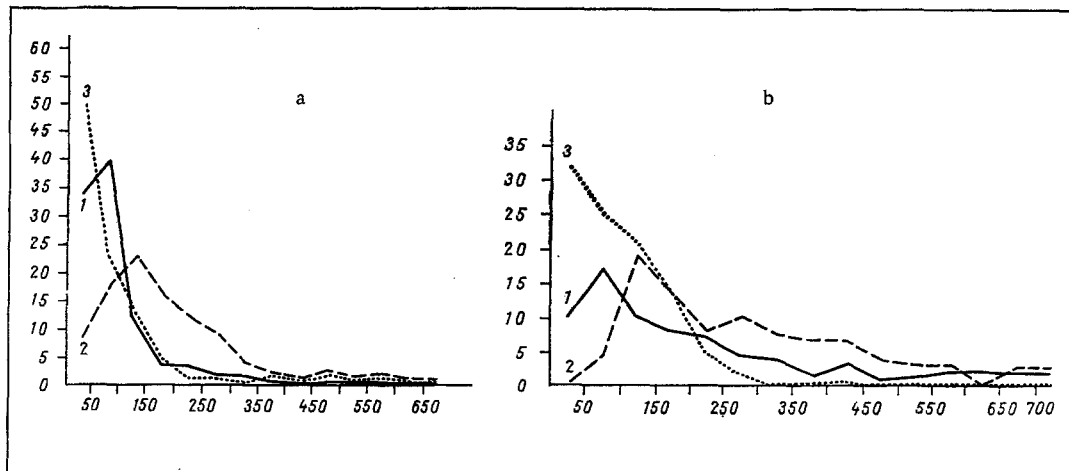


Fig. 2. Curve of distribution of amplitude of responses to dorsiflexion of ankle at different speeds. a) At angular velocities of 25-199 °C/sec; b) angular velocities of 200-400 °C/sec. 1) Healthy subjects, 2) patients of group 1, 3) of group 2. Abscissa, amplitude (in μ V); ordinate, number of cases (in %).

back a stretch reflex was elicited by passive dorsiflexion of the ankle. In the course of the test 40-60 dorsiflexions were given with an interval of 10-15 sec between them. The electromyogram of the soleus muscle and movements of the ankle joints were recorded. The degree of amplification used for recording the EMG was 10 μ V to 1 mm, and for recording joint movements 1° to 1 mm. The velocity of dorsiflexion varied from 25 to 400 °C/sec.

EXPERIMENTAL RESULTS

The results showed that the threshold velocity for evoking a stretch reflex differed considerably in the patients of the different groups (Fig. 1). The lowest values were obtained for the patients of group 1 and the highest for those of group 2. The threshold velocity for the healthy subjects was intermediate in position and the difference compared with the patients of group 2 was statistically significant. The magnitude of the responses also differed in the patients of different groups, as will be clear from the distribution curves. At low and average angular velocities (from 25 to 199 °C/sec; Fig. 2a) a characteristic feature distinguishing the patients of group 1 from the healthy control was a shift of the peak of the curve to the right, toward higher amplitudes, whereas in group 2, on the other hand, the curve was shifted to the left, toward lower amplitude. The distribu-

tion of cases was much more uniform for group 1 than for group 2, in which small responses predominated sharply. The distribution curves based on the results obtained with high angular velocities (group 200 to 400 °C/sec) showed roughly the same pattern (Fig. 2b).

The results show that the character of the stretch reflex in patients with clonus was close to normal, or even showed a higher level of excitation, in agreement with data in the literature [4]. In the patients without clonus, on the other hand, reflex excitability was considerably depressed, so that the threshold of the responses were raised and their amplitude reduced.

Because of these results, attention was directed to the difference in the degree and character of recovery of functions in these patients. Comparison of the ability of different groups of patients to contract their calf muscles actively showed that in 9 out of 10 patients in group 1, during the attempt to carry out voluntary movements activity was observed in the calf muscle; in the patients of group 2, on the other hand, activity was observed in only 5 of the 12 patients. Eight of the 10 patients in group 1 but only 3 of the 12 patients in group 2 could walk or move about. The gamma-system is evidently more activated in patients with clonus [3], and this is a favorable condition for restoration of motor function.

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MECHANISMS OF SENSATION OF RESPIRATORY DISCOMFORT DURING ARTIFICIAL VENTILATION OF THE LUNGS

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The primary reason why hyperventilation is necessary in patients with paralysis of the respiratory muscles is insufficiency of the Hering-Breuer inhibitory reflex.

KEY WORDS: paralysis of the respiratory muscles; artificial ventilation of the lungs; dyspnea; vagotomy.

Patients with paralysis of the respiratory muscles experience respiratory discomfort even though the artificial ventilation of the lungs maintains the normal composition of their blood gases. To overcome respiratory discomfort, the pulmonary ventilation must be increased by 20-30%. This leads to hypocapnia. The sensitivity of the respiratory center to CO₂ rises. The patients therefore require additional ventilation of their lungs [1-3].

But why do the patients require an increase in their lung ventilation even before the onset of hypocapnia?

The investigation described below showed that this is because of insufficiency of the Hering-Breuer inhibitory reflex in these patients.

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