THE EFFECT OF MECHANORECEPTORS OF THE URINARY BLADDER UPON THE STRIATED MUSCULATURE

Report I. The Effect of Mechanoreceptors of the Urinary Bladder on the Striated Musculature Taking Part in the Act of Micturition

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In previous reports [2, 3, 4] it was shown that impulsion in the afferent nerves of the urinary bladder gives rise to certain reflex changes in the tonus of its musculature and the musculature of the urethra, which differ during the filling of the urinary bladder and during its evacuation. It was established that this difference in the reactions is determined by a differing intensity in the afferent impulses [1, 12]. A number of investigators, having studied the reflex changes during the act of micturition, also noted involvement of a definite group of skeletal muscles in this act.

Thus, D. Denny-Brown and E. Robertson [9], S. Muetlner [13] et al., observed contraction of the abdominal muscles during the act of micturition. J. Evans [10] recorded inhibition of the efferent impulses in the nerves innervating the m. levator ani, m. bulbocavernosus, and the muscle of the external urethral sphincter.

In addition, many investigators noted relaxation of the external sphincter, which is composed of striated muscle [7, 8, 9, 11, et al.].

In this work we report the results of the investigation, whose purpose was to study the reaction of the external sphincter and the oblique abdominal muscle during the filling of the urinary bladder and at the time of its evacuation.

EXPERIMENTAL METHOD

The experiments were carried out on cats, kept under urethan or nembutal narcosis. The narcotic was injected intravenously. In all, 33 experiments were set up. The action potential of the muscles was recorded by using a double-channeled cathode oscillograph with an amplifier; the monitored band of the latter was set at rectilinear, within the bounds of 10 to 500 cps.

For the conduction of the action potentials of the muscles, we used needle-shaped silver electrodes. Stimulation of the mechanoreceptors in the urinary bladder was carried out by filling the bladder with air under a determined pressure. The latter was recorded on a smoked kymograph drum, on which a record was also made of respiratory movements.

EXPERIMENTAL RESULTS

During the time that the urinary bladder remained empty, we noted the background activity of the muscles of the external sphincter as well as the abdominal muscles (Fig. 1a; Fig. 2a). It was shown that with stimulation of the mechanoreceptors in the urinary bladder, the lowest threshold is observed for the reflex giving rise to alterations in the muscular activity of the external sphincter; in association with this, an increase occurs in the bioelectrical activity of these muscles, at the same time that the activity of the oblique muscles of the abdomen remains the same (see Fig. 1b). As has been shown earlier [2, 4], at this time the impulsion in the n. pudendus, innervating the urethra, becomes stronger; and the tonus of the latter increases.

A small increment in the strength of stimulation of the urinary bladder mechanoreceptors continued, as before, to cause an increase in the biopotentials of the muscles of the external sphincter, while the activity of the abdominal muscles was somewhat inhibited (see Fig. 1c). Further intensification of the stimulation gave rise to rhythmic changes in the bioelectric activity of the muscles of the external sphincter, analogous to the strengthening and weakening periods of efferent impulsion to the urethra via the n. pudendus; at this time the activity of the abdominal muscles continued to be inhibited (see Fig. 1d). Subsequent increase in the strength of stimulation caused inhibition of the activity...
Fig. 1. Changes in the activity of the muscles in the external sphincter of the urethra and the oblique abdominal muscle with varying strengths of stimulation to the mechano-receptors of the urinary bladder. 

a) Background activity of the muscles of the external sphincter and the oblique abdominal muscle with the urinary bladder empty; b) pressure in the urinary bladder: 8 mm of mercury, showing that the activity of the external sphincter is increased, and the pressure of the abdominal muscles is unchanged; c) pressure in the urinary bladder: 11 mm of mercury, showing an increase in the activity of the external sphincter and inhibition of the abdominal muscles; d) pressure in the urinary bladder: 18 mm of mercury, showing rhythmic activity of the external sphincter and inhibition of the activity of the abdominal muscles; e) pressure in the urinary bladder: 40 mm of mercury, showing inhibition of the activity of the external sphincter and strengthening of the abdominal muscles; f) pressure in the urinary bladder: 146 mm of mercury, showing inhibition of the activity of the external sphincter and strengthening of the abdominal muscles, but less than in Fig. 1e. Significance of the curves (from above downward): action potentials of the muscles of the external sphincter, time marks - 1 second, action potentials of the oblique abdominal muscle.