MAGNUS REFLEXES IN HUMAN THORACIC MUSCLES

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Just as in animals, muscles of the human thorax have respiratory and postural activity. Magnus reflexes can be elicited in the muscles of the human thorax, but for this to occur these muscles must be in a state of well-marked postural tone.

Unlike the diaphragm, the muscles of the thorax not only perform a respiratory function but also help to maintain the posture of the trunk. Accordingly both respiratory volleys and tonic, postural activity can be recorded in them.

The double function of the thoracic muscles – respiratory and postural – is reflected in the character of their innervation [1, 2, 6, 11].

The postural activity of the thoracic muscles is seen most clearly in animals decerebrated by Sherrington's technique, in which the tone of the antigravity muscles is considerably strengthened. The postural character of the tone of these muscles is proved by the fact that Magnus reflexes spread to them.

The investigation described below showed that Magnus reflexes can be elicited under certain conditions in healthy human subjects.

EXPERIMENTAL METHOD

The investigations were carried out on 7 healthy persons (3 men and 4 women) aged from 20 to 40 years.

Electrical activity of the thoracic respiratory muscles was studied with the aid of tinned surface disc electrodes, fixed at the level of the second intercostal space in the midclavicular line and at the level of the 8th intercostal space in the anterior axillary line. Potentials were recorded on a Disa electromyograph. The tests were carried out during quiet and deep breathing, the latter induced by an additional resistance of 100 mm water. During the tests the subjects were in the standing position and with the trunk inclined forward and downward with the palms resting on the floor.

EXPERIMENTAL RESULTS AND DISCUSSION

When the activity of the thoracic muscles was recorded with surface electrodes in quietly breathing subjects, as a rule no activity or only very weak activity was recorded in inspiration. This agrees with the observations of other workers [3-5, 8, 9].

With the trunk inclined forward and downward, with the hands resting on the floor, the subjects developed marked tonic activity of the thoracic muscles. Against this background rotation of the head to the left induced an increase in the electrical activity of the left thoracic muscles (Fig. 1). Changes in the activity of the muscles of the opposite side varied from complete disappearance to a very small decrease, but in isolated experiments a small increase in activity was observed.

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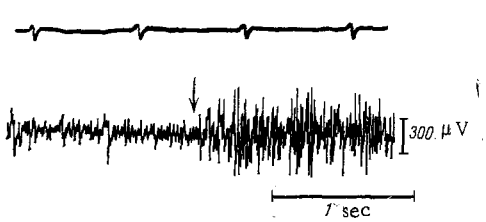

Fig. 1

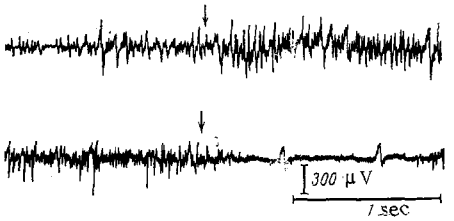

Fig. 2

Fig. 1. Electromyogram of subject in standing position (electrodes fixed at the level of the 8th intercostal space). Top – electrical activity (except ECG) absent; bottom – during forward flection of the trunk tonic electrical activity is recorded. Turning the head to the side (arrow) induces an increase in electrical activity of the same side.

Fig. 2. Electromyogram during forward flection of the trunk. Tonic electrical activity is recorded. Top – inclining the head backward (arrow) induces an increase in electrical activity; bottom – inclining the head downward (arrow) induces a decrease in electrical activity.

With the head inclined backward the activity of the thoracic muscles increased on both sides. With the head inclined downward, as a rule activity was reduced (Fig. 2), but in isolated cases it was unchanged or even increased.

In order to increase the phasic activity of the thoracic muscles (which is weak or completely undetectable under normal conditions when recorded by surface electrodes) the subject was instructed to breathe against an additional resistance of 100 mm water. Under these circumstances marked inspiratory volleys were recorded on the electromyogram. Changes in the position of the head as a rule did not affect phasic respiratory activity of the thoracic muscles. If changes did occur, they did not obey the laws of Magnus reflexes but were manifested as a general increase in the electrical activity of the thoracic muscles.

Changes in the position of the head thus induced regular changes in the electrical activity of the thoracic muscles only when their postural tone is raised. Changes in the position of the head had no regular effect on the phasic activity of these muscles. This indicates that changes in the activity of the thoracic muscles during rotation of the head are independent of biomechanical factors and, in particular, on the redistribution of the load on the muscles. They are produced by Magnus reflexes, which are exhibited in the thoracic muscles of man (just as in animals) when muscle tone is increased. In animals the increase in tone of the thoracic muscles can be obtained by decerebration. The present experiments show that in man simple flection of the trunk is sufficient for this purpose.

It can be concluded from these results that the phasic and postural activities of human thoracic muscles are controlled independently: phasic activity through the bulbar respiratory center, postural activity through postural-tonic mechanisms in which the activity of the cerebellum plays an important role.

These descending influences are integrated in neurons of the spinal centers for the thoracic muscles.

The experiments described above are interesting not only for analysis of the central regulation of the respiratory muscles, but also for the analysis of the general mechanisms of postural tone. Since the discovery of tonic reflexes by Magnus at the beginning of this century it was for a long time considered that they can be detected in man only in diseases of the central nervous system and that under normal conditions they are suppressed.

In 1944, however, Wells [13] showed that Magnus reflexes can be elicited in the limbs of perfectly healthy persons if the extensor muscles are brought into a hypertonic state. These findings were later confirmed by other workers [7, 12].

The present experiments show that Magnus reflexes can also be elicited in the thoracic muscles of perfectly healthy persons, but for this to occur these muscles must be in a state of well-marked postural tone.

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