PARTICIPATION OF CONTRACTILE ACTIVITY
OF SKELETAL MUSCLE IN RESPONSE OF THE
CIRCULATORY SYSTEM TO ORTHOSTASIS

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In experiments on anesthetized cats abolition of the contractile activity of the skeletal muscles
by means of a muscle relaxant sharply increased the initial fall and substantially reduced the
compensatory recovery of the arterial pressure (BP) during the orthostatic test (OT). The
response of the cardiac output during OT was not significantly altered. An increase in BP was
found, synchronized with the motor responses, and could be abolished by the muscle relaxant.
It was shown by means of an artificial circulation (by-passing the left ventricle) that compensa-
tory constrictor responses of resistive vessels during OT are abolished by the muscle re-
lexant. In some experiments, administration of the muscle relaxant significantly increased
the retention of blood in capacitive vessels.

KEY WORDS: orthostasis; contractile activity of skeletal muscle; resistive and capacitive
vessels; retention of blood.

The role of skeletal muscle in the development of compensatory hemodynamic responses to orthostasis in
man and animals has received little study. Although investigations have shown an increase in tone of skeletal
muscles during the orthostatic test in man [12], the importance of this phenomenon for compensatory reactions
of the circulatory system has virtually not been studied.

Interest in this problem is increased, first, by evidence that the "muscle pump" participates in the forma-
tion of certain systemic circulatory responses [5, 7] and, second, by the fact that orthostatic resistance is re-
duced by hypokinesia in man [4, 10] and after blocking of skeletal muscle activity in animals [3].

The objects of the present investigation were: 1) to compare the dynamics of changes in the arterial
pressure (BP) and cardiac output (CO) during orthostasis when the contractile activity of the skeletal muscles
was intact and excluded and 2) to determine the degree of participation of the resistive and capacitive vessels
in the mechanism of the effect of contractile activity of skeletal muscle on the circulatory system during ortho-
stasis.
TABLE 1. Effect of Blocking Contractions of Skeletal Muscles (Listhenon, 0.2 mg/kg) on BP and CO during Orthostatic Test

<table>
<thead>
<tr>
<th>Experimental conditions</th>
<th>BP, mm Hg</th>
<th>CO, ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial value</td>
<td>$\Delta_{20}$</td>
</tr>
<tr>
<td>Intact contractile activity</td>
<td>145±3.3, -14.2±2.1, -7.1±2.0</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Blocked contractile activity</td>
<td>&gt;8.05, -24.3±2.2, -17.9±2.4</td>
<td>&lt;0.02</td>
</tr>
</tbody>
</table>

Legend. $\Delta_{20}$ and $\Delta_{60}$ denote changes after 20 and 60 sec of orthostatic test respectively.

EXPERIMENTAL METHOD

Experiments were carried out on cats anesthetized with urethane (1.0 g/kg). The orthostatic test (OT) was carried out by rotating the table to which the experimental animals were fixed through 45° to the horizontal plane in 3 min. BP was recorded in the femoral artery by means of a mechanotron electromanometer [6]. BP was recorded continuously by the inflatable cuff detector of an RK-1 electromagnetic flowmeter [8], recording the volume velocity of the blood flow in the ascending aorta. During the experiments the animals were artificially ventilated.

Experiments with an artificial circulation (by-passing the left ventricle) were carried out in accordance with the scheme described previously [7]. The pumping function of the left ventricle was replaced by pumping a constant volume of blood into the aorta through the iliac artery by means of a constant delivery pump at the rate of 80-100 ml/kg/min from a reservoir into which blood was taken from the left atrium. Under these conditions the tone of the resistive vessels could be estimated from the BP level. The state of the capacitive vessels was judged from the degree of retention of blood in the vascular system, reflected in changes in the blood level in the reservoir (a fall of level corresponded to an increase in retention of blood, mainly in the capacitive vessel).

To block the contractile activity of the skeletal muscle, the muscle relaxant listhenon was used in a dose of 0.2 mg/kg. This dose, according to observations of Danilov et al. [1], is under one-fiftieth of the dose with ganglion-blocking action. The present writer has shown [5, 7] that this dose of listhenon does not affect reflex vascular responses in cats under urethane anesthesia. Cessation of rhythmic respiratory movements of the