

**Topic Category: 5. Neuroscience**

**Central Neural Pathways Controlling Skeletal Muscle Shivering**

Shaun F. Morrison and Ellen Paula Santos da Conceição

The authors are members of the American Physiological Society.

Department of Neurological Surgery. Oregon Health & Science University. Portland, OR 97239 USA

**Introduction:** Skeletal muscle shivering is the most important source of thermogenesis in the human cold-defensive maintenance of core body temperature ( $T_{core}$ ) and the elevated  $T_{core}$  during fever. The thermoregulatory reflex pathway through which skin and core cooling, or injection of prostaglandin E<sub>2</sub> into the preoptic area of the hypothalamus, leads to activation of skeletal muscle shivering is only partly understood. On the other hand, other neural circuits provide a potent inhibitory regulation of shivering.

**Objective:** To demonstrate the tonic inhibitory influence of neurons in the vLPO on skeletal muscle shivering

**Material and Methods:** EMG activities in masseter, neck and gastrocnemius muscles were recorded in Inactin-anesthetized rats during cold exposure or injection of PGE<sub>2</sub> into the preoptic hypothalamus.

**Results** Cold-evoked and febrile shivering EMGs were eliminated by activation of neurons in the ventral part of the lateral preoptic nucleus (vLPO), or by increasing the discharge of neurons in the paraventricular hypothalamus, in the nucleus of the tractus solitarii, or in the ventrolateral medulla. Inhibiting neuronal discharge or blocking glutamate receptors in the vLPO elicited a sustained increase in shivering EMGs in warm rats.

**Conclusions:** These results indicate the strong, tonic inhibitory influence of neurons in the vLPO on skeletal muscle shivering, likely through a GABAergic input to shivering

premotor neurons in the rostral raphe pallidus. The discovery of the vLPO and other neuronal populations capable of inhibiting shivering supports the potential for the therapeutic control of shivering in the settings of neurogenic fever, brain injury, or induction of hypothermia.

**Keywords:** Central neural pathways, skeletal muscle shivering, neuron activation, rats

**Supported by** USPHS NIH grant R01 NS091066.