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Lack of effect of diffuse noxious inhibitory controls triggered by cold on trigeminal convergent neurons in the anaesthetized rat.

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INTRODUCTION

Noxious stimuli activate supraspinal descending inhibitory controls, providing a negative feedback mechanism to dampen the nociceptive transmission at the level of the spinal cord and the trigeminal system. Orofacial nociception thus, can be regulated by heterotopic application of noxious stimuli, a phenomenon also called diffuse noxious inhibitory controls (DNIC). The present study investigated the effect of DNIC triggered by noxious cold or heat stimulation on trigeminal convergent nociceptive neurons and blood pressure.

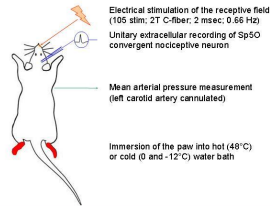
METHODS

Male Sprague-Dawley rats (280-300g) were anesthetized with halothane 0.6%, N₂O 20%, O₂ 70% and paralyzed by pancuronium bromide. Unitary extracellular recordings were obtained from spinal trigeminal nucleus oralis (Sp5O) convergent nociceptive neurons. Electrical square-wave stimuli (2 msec duration) were applied through a pair of stainless steel stimulating electrodes inserted subcutaneously into the center of the previously delineated receptive field.

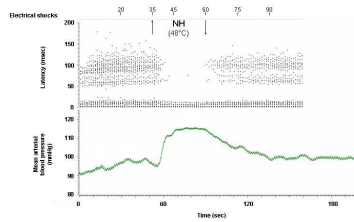
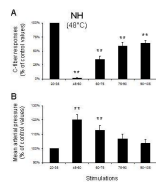
The thresholds for obtaining A- and C-fiber responses were determined. Post-stimulus histograms were analyzed to distinguish responses due to A- and C-fiber inputs, according to their latencies.

Sequences of 105 electrical stimulations (0.66 Hz, 2ms duration, 2 fold C-fiber threshold intensity) were delivered. Between the 35th and the 80th stimuli, one animal paw was immersed into hot (48°C) or cold (0 and -12°C) water.

The mean arterial blood pressure (MAP) was simultaneously monitored and MAP values were calculated from the area under the curve.



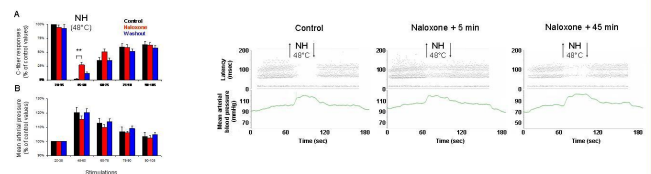
HETEROTOPIC NOXIOUS HEAT STIMULATION DEPRESSES C-FIBER-EVOKED RESPONSES AND INCREASES MEAN ARTERIAL PRESSURE



A- The C-fiber-evoked responses of Sp5O convergent nociceptive neurons were strongly depressed (88.4 ± 0.7%) during the immersion of the hindpaw in hot water (48°C).
B- Noxious heat (48°C) induced a significant increase of MAP: 23.1 ± 3.9%. [All tested units were under the influence of DNIC, n=11]
* p ≤ 0.001 compared to corresponding 20-35 stimulations.

Example of the inhibitory effect induced by the immersion of the hindpaw in hot water (48°C) upon the response of one Sp5O convergent neuron to percutaneous suprathreshold (2T) electrical stimulation of its RF. Each spike was represented as a dot. Sequence of 105 electrical stimulations (0.66 Hz, 2 msec duration) and noxious heat application (NH) were illustrated. Simultaneous increase in mean blood pressure was represented.

SYSTEMIC NALOXONE REDUCES THE NEURONAL INHIBITION EVOKED BY NOXIOUS HEAT STIMULATION

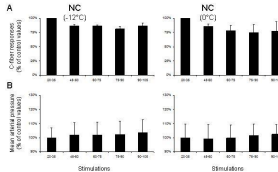


A- Systemic naloxone administration (0.4 mg/kg) significantly decreases the efficiency of heterotopic noxious heat (48°C). (72.7 ± 4.2% versus 98.4 ± 0.7%; ** p ≤ 0.001)

B- MAP is less increased during the immersion of the hindpaw in hot water (48°C) after the administration of naloxone (N). [All tested units were under the influence of DNIC, n=11]

Systemic naloxone administration (0.4 mg/kg) reversibly decreased the inhibitory effect induced by the immersion of the hindpaw in hot water (48°C) upon the response of one Sp5O convergent neuron to percutaneous suprathreshold (2T) electrical stimulation of its RF. Each spike was represented as a dot. Sequence of 105 electrical stimulations (0.66 Hz, 2 msec duration) and noxious heat application (NH) were illustrated. Mean blood pressure was represented.

HETEROTOPIC NOXIOUS COLD STIMULATION HAS NO EFFECT ON NEURONAL RESPONSES AND MEAN ARTERIAL PRESSURE



A- The C-fiber-evoked responses of Sp5O convergent nociceptive neurons were slightly but not significantly depressed (13.5 ± 0.2% and 14.3 ± 0.4%) during the application of -12 and 0°C noxious cold to the hindpaw respectively.
B- Noxious cold (-12 and 0°C) did not change significantly MAP. [n=4 neurons for each temperature]

Lack of effect during the immersion of the hindpaw in cold water (-12°C and 0°C) upon the response of one Sp5O convergent neuron to percutaneous suprathreshold (2T) electrical stimulation of its RF. Each spike was represented as a dot. Sequence of 105 electrical stimulations (0.66 Hz, 2 msec duration) and noxious cold application (NC) were illustrated. Simultaneous mean blood pressure was represented.

CONCLUSION

Our results have shown that trigeminal nociceptive activity can be depressed by heterotopic hot thermal stimulation. This phenomenon also called diffuse noxious inhibitory controls (DNIC), as in the spinal cord, is in part opioid dependent. The present results suggest that, contrary to human, in the anesthetized rat, DNIC can not be triggered by noxious cold stimulation.