Spring 2018

Contributions of aδ nociceptors to the nociceptive withdrawal response in intact unanesthetized rats

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Contributions of Aδ Nociceptors to the Nociceptive Withdrawal Response in Intact Unanesthetized Rats

An Honors College Project Presented to

the Faculty of the Undergraduate

College of Sciences and Mathematics

James Madison University

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May 2018

Accepted by the faculty of the Department of Biology, James Madison University, in partial fulfillment of the requirements for the Honors College.

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PUBLIC PRESENTATION

This work is accepted for presentation, in part or in full, at Biosymposium in April 2017 and 2018, at the Society for Neuroscience Annual Meeting in November 2017, at SYNAPSE in April 2017 and April 2018, at the Central Virginia Society for Neuroscience in March 2017, and at the TriBeta National Conference in May 2018.

Abstract

The nociceptive withdrawal response (NWR), characterized by rapid withdrawal of stimulated body parts, can be evoked by stimulation of two classes of sensory nociceptors: Aδ and C-fibers. Previous studies revealed conflicting results concerning the factors that determine the direction and magnitude of the NWR. Some studies showed that the direction of the NWR depends upon stimulus location. In contrast, other studies, including those from our laboratory, showed that the direction of the NWR does not depend on stimulus location but rather is modulated by posture. However, it is likely that the heat stimuli delivered in our studies stimulated a mixture of C-fiber and Aδ nociceptors, in which the effect of C-fibers could have obscured the effect of Aδ nociceptors due to contrasting receptive field sizes. C-fibers have large receptive fields, sometimes encompassing the whole paw of the rat, while Aδ nociceptors have smaller receptive fields. Consequently, we hypothesized that stimulus location would affect the Aδ but not C-fiber evoked NWRs. Our overall goal was to use three different methods to *preferentially* stimulate Aδ nociceptors to determine if the NWR depended upon stimulus location.

Sprague-Dawley rats were placed on a mesh or glass surface, and the plantar aspect of the hind left foot was stimulated in five locations with brief electrical (200 μs), heat pulse (100 ms), or continuous short duration (<5 s) heat stimuli, all of which are known to preferentially stimulate Aδ nociceptors. Upon stimulation, the rat rapidly withdrew and then replaced its paw on the surface. The initial and final positions of the foot were recorded using a camcorder placed underneath the surface. The difference between the initial and final positions represented the NWR response vector.

Consistent with previous studies, for electrical, heat pulse, and short duration continuous heat, we found no statistically significant dependence of stimulus location on the direction and

magnitude of the NWR in rostral-caudal and lateral-medial axes or in the change in foot angle from initial to final positions, even though only Aδ nociceptors were stimulated. However, the direction and magnitude could be explained in part by the initial position of foot prior to movement. For example, when the foot was initially rostral the movement was caudal, and when initially caudal the movement was rostral, thus avoiding disruption of the rat's balance.

Our results falsify the hypothesis that Aδ-evoked NWRs vary with stimulus location and suggest, based on the effects of initial paw position, that over evolution the NWR has traded off optimal withdrawal movement direction for maintaining postural stability.