What, Indeed, Do Climbing Fibers Signal?

Some Cerebellar Microcomplexes Appear to Monitor the Activity in Spinal Nociceptive Withdrawal Reflex Modules

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KEYWORDS: climbing fibers; cerebellar microcomplexes; nociceptive receptive fields; spinal reflex modules

Although the olivo-cerebellar climbing fiber system is pivotal to cerebellar function, to date there is little consensus with regard to what climbing fibers actually do. Here we test the hypothesis that climbing fibers defining individual cerebellar microcomplexes convey highly integrated information reflecting the activity of specific spinal reflex modules.

To this end, cutaneous nociceptive receptive fields of spinal withdrawal reflex modules acting on single forelimb muscles were mapped and compared to receptive fields of climbing fibers projecting to cerebellar pars intermedia (sagittal zones C1, C3, and Y) in barbiturate-anesthetized cats. In addition, the convergent muscle afferent input to individual climbing fibers was analyzed with reference to characteristics of the associated reflex module. Quantitative methods were used for both mapping and comparing receptive fields. Individual cutaneous receptive fields in the two systems could readily be matched, and matched pairs exhibited a high degree of similarity with regard to detailed distributions of sensitivity. Moreover, muscle afferents from a given spinal reflex module were found to preferentially target climbing fibers with cutaneous receptive fields similar to that of the module itself. These afferents also targeted climbing fibers in other microcomplexes, but to a lesser extent.

Our findings suggest that climbing fiber input to individual cerebellar microcomplexes in pars intermedia represents highly integrated information reflecting (1) cutaneous input to an individual spinal withdrawal reflex module, (2) muscle afferent input from the muscle that constitutes the output from that module, and (3) mus-

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Ann. N.Y. Acad. Sci. 978: 513–514 (2002).

cle afferent input from muscles that constitute the output from functionally related modules. This suggests that an individual climbing fiber signals cutaneous sensory events reflecting activity of a single muscle conditional upon the functional state of the muscle itself and that of functionally related muscles.

ACKNOWLEDGMENTS

This work was supported by the Swedish Medical Research Council Projects No. 10569 and 1013, the Medical Faculty of Lund University, Astra Hässle Inc., Knut and Alice Wallenberg's Foundation, Elsa and Thorsten Segerfalk's Foundation, Greta and Johan Kock's Foundation, the Crafoordska Foundation, and The Royal Physiographic Society in Lund.

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