Follow the Pain

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The morphological and physiological complexity of multidimensional and multilevel processing of pain-related information limits our ability to understand pain perception. All levels difficult. To be able to comprehend pain related information from many levels along the pain neuroaxis, an integrative approach, which encompasses both information about neuronal activity but also predefined and novel undefined connectivity within networks associated to pain related sensory information, is required. To this end, my lab is undertaking the following: (1) developing novel approaches to investigate the fundamental site of signal detection: the nociceptive terminals. (2) Pain perception and pain related synaptic plasticity can only be resolved if a profound understanding of the exact mapping from individual peripheral receptors to central neurons is known and this is at the base of our research. The information on track and connectivity of nociceptors opens important avenues for exploring and characterising synaptic properties of pain related networks at different levels. To do so we use multiple patch-in-slice recordings, together with voltage-sensitive dye imaging. We also integrate optogenetic methods for both ex-vivo and in-vivo models in order to activate specific pathways. However, the optimal method to evaluate the activity of cortical neurons in response to noxious stimulation is to monitor their activity in-vivo while simultaneously stimulating peripheral receptors. To this end we use advanced in-vivo multiphoton imaging, together with electrophysiological recordings, in order to define and characterise the neuronal networks, which respond to stimulation of individual pain receptors at the periphery.

We hope to map out connections through the nociceptive related neuroaxis that convey information from single receptors to their destination, at the level of primary somatosensory cortex. By identifying this pathway, we will define local circuits processing of nociceptive information at each transmission junction. These results will explain the physiological behaviour of neuronal circuits during acute noxious stimuli. This behaviour will underlie the sensory-descriptive component of nociceptive pain. Moreover it will produce a basis for studying modulations of circuits which are mediated by perpetual pathological stimuli. This project is funded by ERC grant agreement n° 260914

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