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Laminar analysis of slow wave activity in rat somatosensory cortex

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Slow wave activity (SWA) emerging in natural slow wave sleep (SWS) is characterized by rhythmically alternating states. In the up-state, synaptic activity and cellular firing is increased while the down-state is essentially silent. The exact origin of this oscillation is still not clarified, however, human data indicates that SWA is mainly generated in supragranular layers. To compare human results to animal data, we recorded local field potential, current source density (CSD) and multiple-unit activity (MUA) from the trunk region of the rat somatosensory cortex with a 24 contact silicon multielectrode. The animals were anesthetized with ketamine/xylazine to model natural SWA emerging in SWS. During the up-states we have found strong inward synaptic/trans-membrane currents in the superficial layers of the cortex, mostly in layers II and III and to a lesser extent in layer IV. This sink was surrounded by two current sources located close to the cortical surface, mostly in layer I and in the deeper layers V and VI. The inverse of the above pattern was observed in the down-state. The maximal MUA was recorded from layer IV and V in the up-state. Our results suggest that the generator mechanism of SWA in rodents is partially similar to that of humans, since the most impressive current sink is located superficially in both cases. However, the existence of a substantial source in deep layers and the deep layer MUA maximum may reveal possible differences between the two conditions.