KETAMINE/XYLAZINE INDUCED SLOW (<1.5 Hz) OSCILLATIONS IN THE RAT PIRIFORM (OLFACTORY) CORTEX ARE FUNCTIONALLY CORRELATED WITH RESPIRATION

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The occurrence of low frequency (< 1.5 Hz) cerebral cortical oscillations during slow wave sleep (Steriade et al., 2001) has recently lead to the suggestion that this pattern of activity is specifically associated with conditions in which the brain is mostly closed to external inputs and running on its own (Timofeev et al., 1996a; Steriade, 2000, Destexhe and Sejnowski, 2001). In the current experiments we have used a combination of *in vivo* intracellular and extracellular field potential recordings obtained under conditions of ketamine/xylazine anesthesia to examine slow wave behavior in the olfactory system (Figure1). We demonstrate the occurrence of low frequency oscillations in field potentials of both the olfactory bulb and cortex and in the membrane potentials of cortical pyramidal cells. By monitoring ongoing breathing, we also show that these oscillations are all correlated with the natural breathing cycle (Figure 1H). Using a tracheotomized preparation, we demonstrate that the amplitude and regularity of the oscillations as well as their patterns of correlation are disrupted when air is no longer entering the nose. All temporal relationships were restored, however, when air was pulsed into the nostrils. We conclude that, in the olfactory system, there is a direct relationship between the occurrence and timing of slow oscillations and the ongoing periodic sensory input resulting from respiration. We believe this finding has important functional as well as evolutionary implications.

List of most relevant papers related with the topics

Destexhe A, Sejnowski TJ (2001) Thalamocortical assemblies, Monographs of the Physiological Society (49), New York: Oxford UP.

Steriade M (2000) Corticothalamic resonance, states of vigilance and mentation. Neuroscience 101:243-276

Steriade M, Timofeev I, Grenier F (2001) Natural waking and sleep states: a view from inside neocortical neurons. J Neurophysiol 85:1969-1985

Timofeev I, Contreras D, Steriade M (1996) Synaptic responsiveness of cortical and thalamic neurones during various phases of slow sleep oscillation in cat. J Physiol 494:265-278

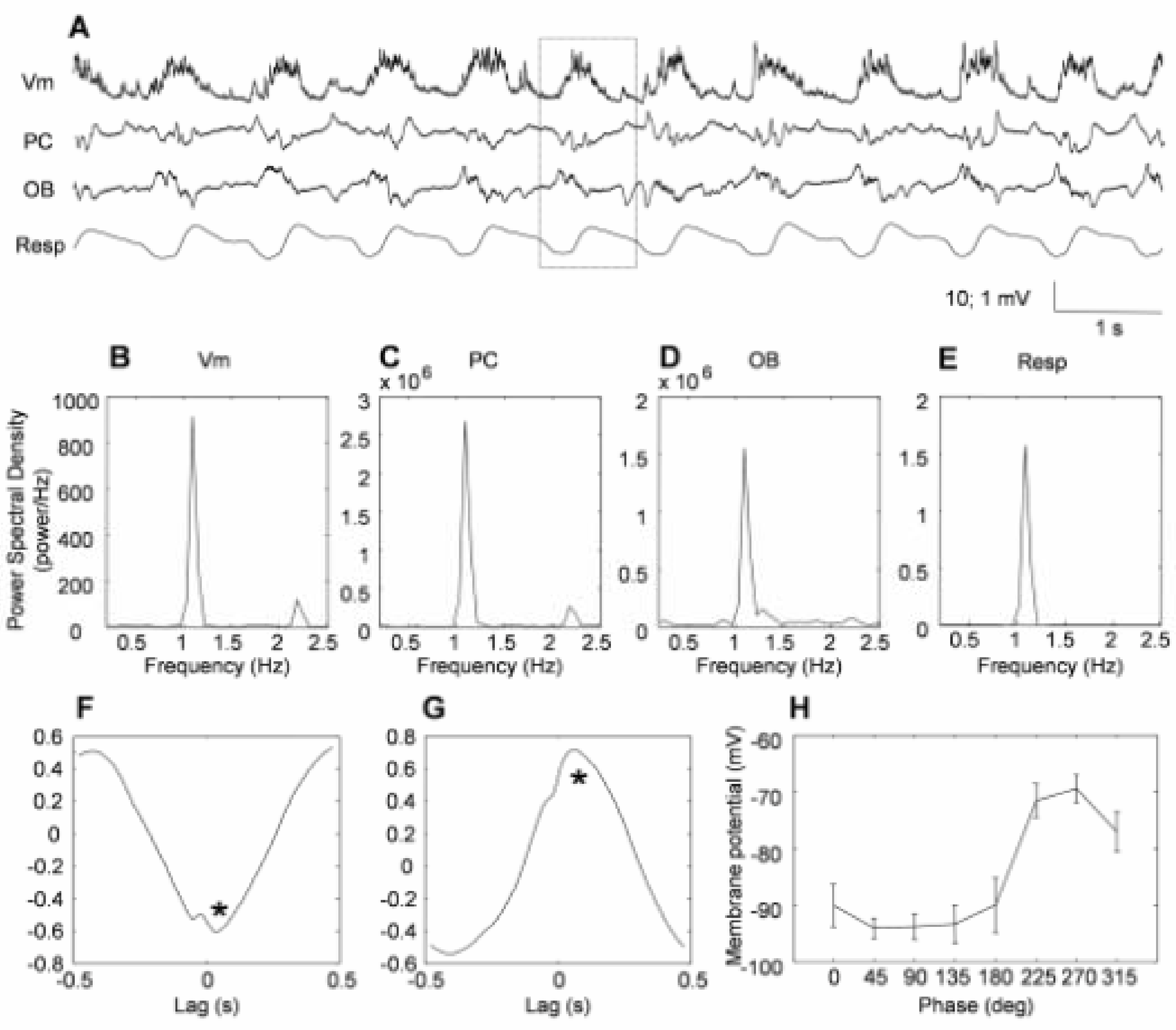

Figure 1: Slow oscillations in the olfactory system during ketamine/xylazine anesthesia. *A.* Representative raw traces of pyramidal cell membrane potential (Vm), local field potentials in layer I of piriform cortex (PC), in granule cell layer of the olfactory bulb (OB), and respiratory wave as recorded from chest wall movements (Resp). All traces were recorded simultaneously. The vertical scale for the intracellular records is 10 mV, while the extracellular records are 1 mV. The graphs labeled B-E, indicate the power spectral density for the recorded membrane potentials (*B*), the local field potentials recorded in the piriform cortex (*C*), in the olfactory bulb (*D*), and ongoing respiration (*E*). *F.* Representative cross-covariance between membrane potential of a layer II/III pyramidal cell and layer I olfactory cortex local field potentials. *G.* Representative cross-covariance between membrane potential and local field potentials in the granule cell layer of the olfactory bulb. *H.* Respiratory-wave-triggered-average of membrane potential showing the dependence of membrane potential slow oscillations on respiratory phase.