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Maintaining network activity in submerged hippocampal slices: importance of oxygen supply

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Abstract:

Studies in brain slices have provided a wealth of data on the basic features of neurons and synapses. In the intact brain, these properties may be strongly influenced by ongoing network activity. Although physiologically realistic patterns of network activity have been successfully induced in brain slices maintained in interface-type recording chambers, they have been harder to obtain in submerged-type chambers, which offer significant experimental advantages, including fast exchange of pharmacological agents, visually guided patch-clamp recordings, and imaging techniques. Here, we investigated conditions for the emergence of network oscillations in submerged slices prepared from the hippocampus of rats and mice. We found that the local oxygen level is critical for generation and propagation of both spontaneously occurring sharp wave–ripple oscillations and cholinergically induced fast oscillations. We suggest three ways to improve the oxygen supply to slices under submerged conditions: (i) optimizing chamber design for laminar flow of superfusion fluid; (ii) increasing the flow rate of superfusion fluid; and (iii) superfusing both surfaces of the slice. These improvements to the recording conditions enable detailed studies of neurons under more realistic conditions of network activity, which are essential for a better understanding of neuronal network operation.

Key-words: GABAergic interneuron, gamma oscillation, hippocampus, *in vitro*, rodent, sharp wave-ripple oscillation