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Enhanced Dendritic Action Potential Backpropagation in Parvalbumin-positive Basket Cells During Sharp Wave Activity

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In this study, two-photon imaging and single cell electrophysiological measurements were carried out in PV+ hippocampal interneurons to compare the dendritic calcium dynamics of somatically evoked backpropagating action potentials (BAPs) and in vitro sharp wave oscillation (SPW) activated BAPs at different distances from the soma. In the case of 300 μm thick, non-oscillating slices, the BAP-evoked Ca2+ (BAP-Ca2+) influx propagated along the dendritic tree in a non-uniform manner and its amplitude gradually reduced when measured at more distal regions. In contrast to the evoked BAP-Ca2+s, the spontaneous SPW-induced Ca2+ influx had only a small distance-dependent decrement. Our results suggest that synaptic activity during hippocampal SPWs increases AP backpropagation into distant dendritic segments. Bath application of Nimodipine, a specific Ca2+ channel blocker and tetrodotoxine decreased the amplitude of the somatically evoked Ca2+ influx, which suggests that L-type Ca2+ channels play an important role both during somatically evoked and SPW-induced BAPs.