

SIMULTANEOUS MULTICELLULAR CALCIUM IMAGING AND EXTRACELLULAR ELECTROPHYSIOLOGICAL RECORDING IN RAT HIPPOCAMPUS.

K. Kilborn^{1*}; K. Shimono^{2,3}; G. Lynch²; M. Taketani^{2,3}

¹. Intelligent Imaging Innovations, Inc, Santa Monica, CA, USA

². CNLM, University of California, Irvine, CA, USA

³. Panasonic Technology Development Center, Cypress, CA, USA

A novel technique, which combines high magnification calcium imaging with field electrophysiological stimulation and measurement using a planar electrode array, permits time resolved correlation of electrical and ionic activity in brain slices at the network level. Adult rat hippocampal slices were bulk loaded with fura-2 and placed on a 64 electrode array, which was then fitted to a digital microscopy workstation. A 300 μm^2 region of the slice could be viewed at any given time. Theta burst stimulation was applied, via one of the 64 microelectrodes underneath the slice, in 2s volleys to s. radiatum or s. oriens of field CA1. An image region was selected that included the pyramidal layer in zones adjacent to the stimulation. A rapid elevation of somatic calcium in a subset of the dye-loaded cell bodies was observed at the onset of each volley. By 1s after the volley, calcium levels in most cells returned to near baseline, but a gradual rise in baseline level in between and after 3 burst volleys was also observed. LTP was achieved in some slices. The selective, varied response in $[\text{Ca}^{++}]$ suggest that the observed ion dynamics are a result of either direct dendritic depolarization or activation of Schaffer-commissural synapses. For reasons to be described, the latter is the more plausible explanation. It is hypothesized that the somatic rise is due to the activation of voltage gated calcium channels on the cell bodies. Automated imaging of multiple regions, spatial correlation between ion concentrations and current source density, and LTP research applications are discussed.