Injury and recovery of pyramidal neurons in the rat hippocampus after a single episode of oxidative stress induced by intracerebroventricular injection of ferrous ammonium citrate.

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Abstract

The present study was carried out to elucidate the effect of a single episode of oxidative stress on pyramidal neurons of the rat hippocampus. A significant increase in the number of neurons that were immunolabeled for the toxic lipid peroxidation product, 4-hydroxynonenal (HNE) was observed in field CA3 of the hippocampus, at 1 day, 7 days and 14 days after intracerebroventricular injection of 1 microL of 5 mM ferrous ammonium citrate, compared to ammonium citrate injected controls at these time points. The number of HNE positive cells was fewer at 14 days, compared to 1 day, after ferrous ammonium citrate injection. The changes in HNE immunoreactivity were paralleled by changes in cytoplasmic phospholipase A2 (cPLA2) labeling in the pyramidal neurons in adjacent sections, suggesting that some of the HNE could have arisen as a result of peroxidation of arachidonic acid that was released by cPLA2. Interestingly, despite the HNE and cPLA2 labeling, no loss of neurons was observed in adjacent Nissl and Fluoro-Jade stained sections. Electron microscopy also showed that the HNE or cPLA2 labeled cells had features of injured neurons, rather than necrotic neurons. The reduction of HNE immunoreactivity in neurons at 14 days after oxidative injury, and the absence of cell loss at any of the time intervals, shows that hippocampal pyramidal neurons have remarkable ability to recover from a single episode of oxidative stress, if repeated injury such as seizures / excitotoxicity could be avoided.