Early integrative processes physiologically observed in dentate gyrus during an olfactory associative training in rat.

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Abstract

Modifications of synaptic efficacy in the dentate gyrus were investigated during an olfactory associative task. A group of rats was trained to discriminate between a patterned electrical stimulation of the lateral olfactory tract, used as an artificial cue, associated with a water reward, and a natural odor associated with a flash of light. Monosynaptic field potential responses evoked by single electrical stimuli to the lateral perforant path were recorded in the granular layer of the ipsilateral dentate gyrus prior to and just after each training session. An early increase in this response was observed just after the first learning session but disappeared 24 hours later. Inversely, a synaptic depression developed across sessions, becoming significant at the onset of a last (fifth) session. When a group of naive animals was pseudo-conditioned, no increase was observed and the synaptic depression was noted since the onset of the second session. In a group of rats similarly trained for only one session, and in which EPSPs were recorded throughout the 24 hours that followed, it was demonstrated that the increase lasted at least two hours, while the significant synaptic depression started after the fourth hour. These results are consistent with the early involvement of the dentate gyrus in learning the association between the cues and their respective rewards. These early integrative processes physiologically observed in dentate gyrus suggest early hippocampal processing before dentate gyrus reactivation via entorhinal cortex which will allow long-term memory storage in cortical areas once the meaning of the olfactory cues is learned.