Microtubules to Form Memory

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SUMMARY

Microtunbule-depolymerizing agents cause amnesia. Some signal translocations to the stimulated postsynaptic membrane are essential for inducing LTP in CA1 neurons like AMPA receptors, CaMKII and mRNA. On the other hand, LTP requires protein synthesis and gene expression. This indicates that signals generated at the synapse might be transmitted to the nucleus. Recently, we have reported that LTP-producing stimulation makes new microtubule track between cell body and the stimulated postsynaptic membrane in CA1 neurons. This newly produced microtubule track only to the stimulated postsynaptic membrane might be the route of these bi-directional transportation of signals during LTP formation. This lead us the hypothesis of the "endless memory amplifying circuit" that means gene expression-promoting molecules are translocated from postsynaptic membrane to the cell body and enter into nucleus and activate transcription factors, and gene products, which will probably promote plasticity, may be re-translocated only to the stimulated postsynaptic membrane along microtubules.

INTRODUCTION

It is widely believed that a long-lasting change in synaptic function is the cellular basis of learning and memory (Alkon and Nelson, 1990; Eccles, 1964; Hebb, 1949; Kandel, 1997). The best-characterized forms of such synaptic plasticity are the long-term potentiation (LTP) observed at excitatory synapses in the CA1 region of the hippocampus (Teyler and DiScenna, 1987; Gustafsson and Wigstrom, 1988; Nicoll et al., 1988; Madison et al., 1991; Bliss and Collingridge, 1993; Larkman and Jack, 1995; Nicoll and Malenka, 1995). These synapses, which are countless