Chapter

THE EFFECT OF KAINIC ACID ON THE RAT BRAIN: HISTOLOGICAL, ELECTRON-MICROSCOPICAL AND TWO-PHOTON MICROSCOPICAL STUDY

Mzia G. Zhvania[1,2*], Tamar G. Lordkipanidze[1,2], Maia Kiladze[1], Nadezhda J. Japaridze[1,3], Nato Kotaria[2] and Tamar Z. Bikashvili[2]

[1]Institute of Chemical Biology, Ilia State University. 3/5 K. Cholokashvili Avenue, 0162 Tbilisi, Georgia;
[2]I. Beritashvili Center of Experimental Biomedicine; 14 Gotua Street, 0160 Tbilisi, Georgia;
[3]New Vision University, 1a E. Mikeladze Street, 0159 Tbilisi, Georgia

ABSTRACT

In the present chapter several aspects of kainic acid action on the rat brain structure were presented. Specifically, using histological, electron-microscopical and two-photon microscopical approaches, we elucidated: (i) The pyramidal and interneuron cell loss in different layers of hippocampal CA1 and CA3 areas as a result of kainic acid-induced status epilepticus; (ii) The ultrastructure of neurons, synapses, glial cells and

* Corresponding author: Email: mzia_zhvania@iliauni.edu.ge.

neuropil of hippocampal CA1 area provoked by kainic acid-induced status epilepticus; (iii) The effect of different concentrations of kainic acid on dendritic spine motility of living hippocampal neuron at the different stages of development; (iv) The effect of different concentrations of kainic acid on the density of various types of spines (filopodia, mushroom and stubby spines, alongated, enlarged or thin formes with head or without) in living hippocampal neuron at different stages of development. In all cases several modifications were revealed. Possible consequences of such modifications are discussed.

1. INTRODUCTION

Despite numerous anti-seizure and antiepileptic drugs that have been introduced over the last years, the recent state of epilepsy treatment has been characterized by significant limitations. It is supposed that the majority of existing antiepileptic medications are not truly antiepileptic but represent the symptomatic treatments that do not affect mechanisms of epileptogenesis (Aroniadou-Anderjaska et al. 2008; Pati, Alexopoilos 2010; Schmidt 2011). Therefore, epilepsy today still represents one of the major neurological problems. Future studies of epileptogenesis should lead to the development of new antiepileptic treatments that could successfully cure and/or cease this disease. At present much research into causes and mechanisms of epilepsy is focused on synaptic transmission because the hyperexcitability of synapses can cause seizures. Mutations of the genes involved in synaptic transmission are also known to provoke epilepsy (Anderson 2010;Kang et al. 2010; Hill et al. 2011).Therefore, the most recent seizure medications are directed to regulate the physiological activities of neuron through modulation of synaptic transmission, ion channels or neurotransmitter receptors. Meanwhile, the strategy for epilepsy treatment aiming for stabilization of the structure of "epileptic" neuron is rather unexplored (Wong 2008;Jefreys 2010). However it is generally accepted that seizure activity may stem not only from inappropriate reactive synaptogenesis, but also from a continuing state of neuronal degeneration. Therefore, it is suggested that to optimize the treatment of epilepsy, it is important to study not only the efficacy of different anticonvulsant/antiepileptic drugs in preventing behavioral/electrophysiological seizures and molecular changes, but also to determine how effectively they prevent seizure-induced neuronal damage (Pitkanen et al. 1996; Wong 2005,2008). Taking into consideration this suggestion, the elucidation of