Asthma, respiratory allergy and cough

Computer modeling of neuronal excitation in the Bötzinger complex area

*M. Veternik[1], M. Simera[1], J. Jakus[1], I. Poliacek[1]
[1]Comenius University in Bratislava, Jessenius Faculty of Medicine, Department of Biophysics (Martin, Slovakia)

Complex computer model of respiratory and cough neuronal network was employed to simulate neuronal excitation in the area of Bötzinger complex experimentally executed by microinjection of D, L - homocysteic acid (DLH). Effects of microinjection represented fiber populations providing excitatory drive into expiratory neurons at 2 levels (DLH1 - more synaptic connections with lower synaptic strength and DLH2 - less synaptic connections with higher synaptic strength). Our simulations manifested high level of analogy with cough reflex and breathing changes observed in experiments. Simulated excitations in the Bötzinger complex area resulted in a depression of cough represented by the decrease of cough number (control:16, DLH1:6, DLH2:1) and neuronal activity of lumbar nerve neuronal population during cough (and also during quiet breathing). In spite of shortening of cough phrenic activity (compared to quiet breathing) which was not observed in experiment on animals, our simulations confirm the ability of the computer model to simulate functional processes in neuronal populations (excitation of expiratory augmenting neurons in the Bötzinger complex area). Our results suggest that appropriate computer model of functional neuronal network is capable to validate and predict results obtained on animals (cough depression in present settings).

Keywords: computer model, simulation, neuronal network, neuronal excitability, D, L - homocysteic acid, cough, Bötzinger complex

This work was supported by the Slovak Research and Developement Agency under the contract No. APVV-0189-11 (40%), VEGA No. 1/0126/12 (30%) and by project "Virtual and Simulation Tuition as a New Form of Education at JFM CU in Martin", ITMS: 26110230071, co-funded from EU sources and European Social Fund (30%).