

14. Multiparametric evaluation of brain functions in the Mongolian gerbil in vivo.

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J Basic Clin Physiol Pharmacol 1992 Oct-Dec;3(4):323-42

We have developed the multiprobe assembly (MPA) by which metabolic, ionic and electrical activities can be monitored from the surface of the brain. In the present study we included optical fibers for the monitoring of intracapillary hemoglobin oxygenation by use of the Erlangen Microlight Guide Spectrophotometer (EMPHO-I) from the surface of the gerbil brain. The newly developed MPA provides simultaneous information about oxygen delivery (oxydeoxy Hb), tissue pO₂ level, as well as the intracellular oxygen balance (intramitochondrial redox state). The ionic homeostasis was evaluated by monitoring extracellular K⁺ and Ca²⁺ activities reflecting the permeability changes of cation channels as well as the activities of Na⁺,K⁽⁺⁾-ATPase and other ion linked transport processes. The electrical activities were monitored by a bipolar electrocortical surface probe and DC steady potential. The subjects of the present study were Mongolian gerbils (*Meriones unguiculatus*) anesthetized and operated according to our routine techniques. After 30 min of recovery from the operation each gerbil was exposed to a short anoxia, graded hypoxia, ischemia as well as spreading depression. The results can be summarized as follows: 1. A clear correlation was recorded between the changes in oxydeoxy Hb spectra, tissue pO₂ level and oxidation-reduction state of intramitochondrial NADH under oxygen deficiency situations (hypoxia, ischemia). 2. Blood volume changes under various perturbations monitored by various probes (366 reflectance and EMPHO-I) correlated very well with each other. 3. The degree of inhibition of Na⁺,K⁽⁺⁾-ATPase induced by oxygen deficiency could be interpreted by changes in extracellular levels of K⁺ measured by the surface mini-electrode. 4. Brain stimulation induced by spreading depression mechanism led to transient changes in ionic homeostasis and increase in energy requirements. The major HbO₂ response was an increase in oxygenation due to the large CBF increase as monitored by the laser Doppler flowmeter. 5. Changes in oxy-deoxy Hb under fast scanning of 500-600 nm during 2-3 seconds of bilateral carotid arterial occlusion provided an indirect index for tissue O₂ consumption.

PMID: 1339223 [PubMed - indexed for MEDLINE]