# A simulation model of ischemia in the rat brain

Jerker Westin
Department of Computer Science
Dalarna University
Borlänge, Sweden
jwe@du.se

Lars Hillered
Departments of Neuroscience
and Medical Sciences
Uppsala University Hospital, Sweden
lars.hillered@neurokir.uu.se

Torgny Groth
Department of Medical Sciences
Uppsala University
Uppsala, Sweden
torgny.groth@medsci.uu.se

## ABSTRACT

The aim of this study was to construct a theoretically sound model, including the major steps of brain energy metabolism that would generate simulation results that are compatible with microdialysis data from rat brain ischemia experiments. Modeling and simulations were performed in a MATLAB/SIMULINK environment (The MathWorks inc.) using published experimental data (1). Metabolite concentrations and flows before and during ischemia in rats were also taken from Siesjö (2).

Glucose and oxygen supply were selected as input to the model and concentrations of a number of energy metabolism related metabolites such as lactate and pyruvate were selected as output. In analogy with the work of Cabrera et al (3) energy metabolism was lumped into the following metabolic processes: 1. Glycolysis, 2. Pyruvate oxidation and Krebs cycle, 3. Oxidative phosphorylation, 4. Pyruvate reduction, 5. Lactate oxidation and 6. ATP hydrolysis. These reactions were all assumed to follow hyperbolic kinetics with or without hyperbolic modifiers, such as energy charge modeled as ATP/ADP being a modifier for the rate of glycolysis.

The result of the study was that model simulated curves for complete ischemia fit well to the experimental data for lactate and pyruvate and that the model could produce valid results for different degrees of incomplete ischemia or hypoxia. Our working hypothesis is that this modeling approach will help in the interpretation of microdialysis measurements for detection of secondary brain ischemia in the future.

## ADDITIONAL AUTHORS

Mark Dougherty*, email: mdo@du.se, Björn Sohlberg*, email: bso@du.se and Bo Johansson*, email: bjo@du.se (*Dept. of Computer Science, Dalarna University, Borlänge, Sweden).

## REFERENCES

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