An Integrative Large Varying-Scale Model of Body Fluids, Acid-Base and Cardiorespiratory Functions as a Basis of an Educational Simulator

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INTRODUCTION

An integrative model of body fluids regulation was designed for the purpose of studying problems concerning cardiorespiratory disorders, body fluid disturbances and fluid therapy. This model is a framework for the multimedia medical computerized training simulator "GOLEM" designed for learning how to diagnose and threat critical clinical disorders.

METHODS

For the development of the simulation models we have used developer's tools from MathWorks (Matlab and Simulink). For the basic component construction elements of our simulation models we have used ***simulation chips***. The idea of simulation chips helps us to find a common language between programmers and physiologists in our interdisciplinary team. The detailed structure of the entire model, the complex scheme (including the simulation chips library) is available on the Internet at www.physiome.cz. When building the multimedia components of the simulator we have used developer's tools from Macromedia (Flash MX). The integration of the multimedia components, hypertext and simulation models interface was realized using an original software tool (Control Web, developed by Moravian Instruments), which was originally designed for long distance control and measurement using PC's and the Internet.

RESULTS

The behavior of the model, using various kinds of inputs, correlated well with a number of experimental results pertaining to body fluid, cardiorespiratory and acid-base disorders. A simulator based on this model is an efficient educational tool to help medical students learn acid-base, electrolyte, osmotic and volume disorders and trains them in diagnostic and therapeutic decision making by executing simulated interventions on virtual "patients".

DISCUSSION

The model containing subsystems of circulation, respiration, renal functions, osmotic, ionic and acid-base body fluids equilibrium was described as a set of non-linear differential and algebraic equations of more then 200 variables. The integrative model has a hierarchic varying-scale structure. The core of this ***large varying-scale model*** consists of minimalized interconnected models of the 18 subsystems. The subsystem models allow switching between several models with different distinguishing levels of description. The level of detail of a subsystem must be adequate to the educational purpose and must fit the other subsystems so that some part of the model is not too detailed while another is oversimplified.

CONCLUSION

Multimedia combined with the large varying-scale simulation is becoming an efficient teaching tool to help medical students in learning complicated pathophysiological disorders.