A model of short term cardiovascular regulation

Abstract
A model of short term cardiovascular regulation was discussed. The physiological response to acceleration stress were studied. Results showed that a supine to standing transition leads to a substantial drop in central arterial pressure (CAP), cardiac output (CO), central venous pressure (CVP) and cerebral perfusion unless reflexes are active.

Index Keywords
Blood, Brain, Computer simulation, Vectors; Blood pressure; Cardiology

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**Numerical Issues in Cardiovascular Models**

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**Mathematical Modeling of Human Cardiovascular System for Simulation of Orthostatic Response**

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Mathematical study of the role of non-linear venous compliance in the cranial volume-pressure test

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Abstract
The role of the cerebral venous bed in the cranial volume-pressure test was examined by means of a mathematical model. The cerebral vascular bed was represented by a single arterial compartment and two venous compartments in series. The lumped-parameter formulation for the vascular compartments was derived from a one-dimensional theory of flow in collapsible tubes. It was assumed in the model that the cranial volume is constant. The results show that most of the additional volume of cerebrospinal fluid ($\Delta V_{CSF}$) was accommodated by collapse of the cerebral venous bed. This profoundly altered the venous haemodynamics and was reflected in the cranial pressure $PCSF$. The cranial volume-pressure curve obtained from the model was consistent with experimental data; the curve was flat for $0 \leq \Delta V_{CSF} \leq 20$ml and $35 \leq \Delta V_{CSF} \leq 40$ml, and steep for $20 \leq \Delta V_{CSF} \leq 35$ml and $\Delta V_{CSF} \geq 40$ ml. For $\Delta V_{CSF} > 25$ ml and $PCSF > 5.3$ kPa (40 mmHg), cerebral blood flow dropped. When $PCSF$ was greater than the mean arterial pressure, all the veins collapsed. The conclusion of the study was that the shape of the cranial volume-pressure curve can be explained by changes in the venous bed caused by various degrees of collapse and/or distension.

Author Keywords
Cerebral veins; Cerebrospinal fluid; Cranial pressure; Mathematical model

Index Keywords
Body fluids, Mathematical models, Nonlinear systems, Parameter estimation, Pressure effects; Volume-pressure test; Blood vessels; brain blood flow, pressure volume curve, vein compliance; Intracranial Pressure, Models, Neurological

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Mechanical effects of acceleration on cardiovascular performance
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Abstract
Preliminary results regarding the mechanics of cardiovascular response to the spine are presented. It is shown that the split coefficient matrix (SCM) method with a method of characteristics boundary treatment provides a robust algorithms for cardiovascular simulations. At least one valve is needed below the heart to maintain physiologically reasonable behavior, and the commonly used tube law is too compliant for distented veins.

Index Keywords
Artificial organs, Blood vessels, Cardiology, Computer simulation, Kinematics, Mathematical models, Microcirculation, Physiology; Blood flow, Blood pressure, Life support systems, Physiological reflexes; Biomechanics

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  Computational simulation of blood flow in human systemic circulation incorporating an external force field

**Negative wave reflections in pulmonary arteries**


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**Abstract**

The pulmonary arterial branching pattern suggests that the early systolic forward-going compression wave (FCW) might be reflected as a backward-going expansion wave (BEW). Accordingly, in 11 open-chest anesthetized dogs we measured proximal pulmonary arterial pressure and flow (velocity) and evaluated wave reflection using wave-intensity analysis under low-volume, high-volume, high-volume + 20 cmH2O positive end-expiratory pressure (PEEP), and hypoxic conditions. We defined the reflection coefficient R as the ratio of the energy of the reflected wave (BEW [-]; backward-going compression wave, BCW [+]) to that of the incident wave (FCW [+]). We found that $R = -0.07 \pm 0.02$ under low-volume conditions, which increased in absolute magnitude to $-0.20 \pm 0.04$ ($P < 0.01$) under high-volume conditions. The addition of PEEP increased $R$ further to $-0.26 \pm 0.02$ ($P < 0.01$). All of these BEWs were reflected from a site 3 cm downstream. During hypoxia, the BEW was maintained and a BCW appeared ($R = +0.09 \pm 0.03$) from a closed-end site 9 cm downstream. The normal pulmonary arterial circulation in the open-chest dog is characterized by negative wave reflection tending to facilitate right ventricular ejection; this reflection increases with increasing blood volume and PEEP.
Author Keywords
Hemodynamics; Lung

Index Keywords
pulmonary artery

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