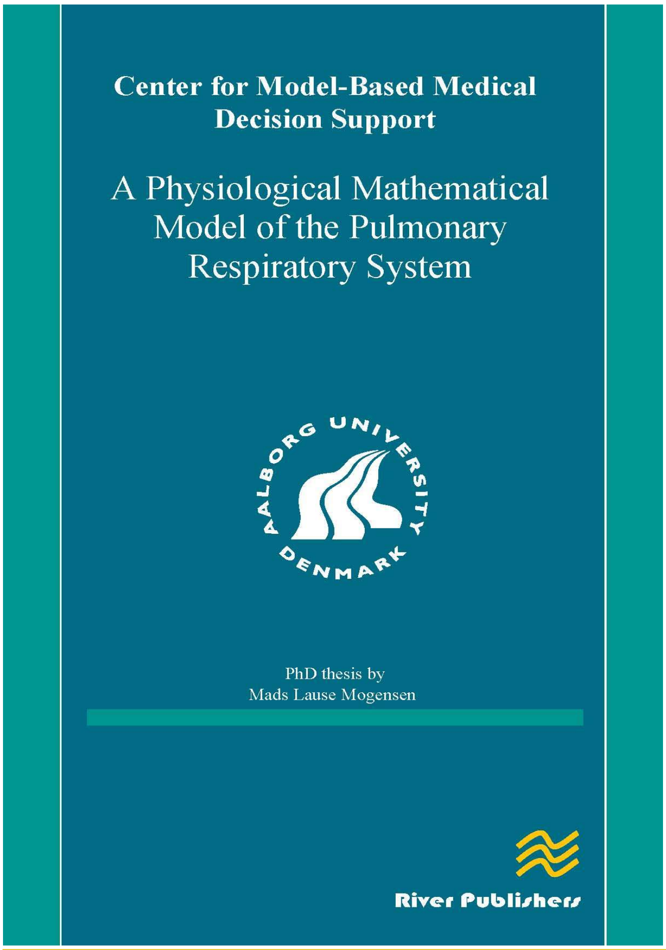
River Publishers

A Physiological Mathematical Model of the Respiratory System

Author: Mads Lause Mogensen, Department of Health Science and Technology, Aalborg University

In patients where mechanical ventilation is required, the aim of mechanical ventilation is to ensure adequate gas-exchange while avoiding ventilator induced lung injury (VILI). Uncertainties exist regarding the causes and prevention of VILI. The effect of mechanical ventilation on the distribution of ventilation, perfusion and gas-exchange in the lungs is not fully understood; especially the effect of gravity is debated in the literature. Furthermore, it has not been determined how alveoli behave during mechanical ventilation and it has not been determined to which extend alveoli opens and close during breathing even for healthy lungs. The first step towards improving ventilator therapy strategies is therefore to understand how the healthy lungs respond to mechanical ventilation. The focus of this project was to develop a mathematical physiological model of the respiratory system consisting of four sub models describing the pulmonary ventilation, perfusion, blood chemistry and gas-exchange during mechanical ventilation. The ventilation model simulates pressure-volume relationships in the lungs and the perfusion model describes the pulmonary perfusion during mechanical ventilation both models being stratified with respect to the effects of gravity. The blood model describes acid-base chemistry of the blood. The gas-exchange model simulates oxygen and carbon dioxide distributions in the respiratory system and simulates e.g. arterial oxygen and carbon dioxide levels during tidal breathing. The models are validated against experimentally obtained data and simulate well a wide range of physiological parameters during breathing. The model has indicated that alveoli in the healthy subjects do not collapse. Furthermore, simulation results show that gravity affects the gas exchange more than what is experimentally observed. This leaves room to speculate that other effects such as anatomical gradients, hypoxic vasoconstriction and bronchodilation may compensate for the effects of gravity on the regional ventilation and perfusion of the lungs.



e-ISBN: 9788792329974
Available From: December 2011
Price:

KEYWORDS:
pulmonary capillaries