Abstract

Obstructive sleep apnea syndrome (OSAS) is a sleep disruption phenomenon, caused by narrowing of the pharyngeal airway. OSAS leads to serious problems such as oxygen desaturation and sleep disruption. This project's main goal was to model choked flow, a condition where additional driving pressure between inlet and outlet of an airway will not lead to increased air flow. In this project, a one-dimensional airway model with mechanical compliance modeled by a tube law was constructed, based on Downing and Ku's one-dimensional artery blood flow model. New solution monitors were developed to efficiently characterize simulation convergence, and the newly constructed software's effectiveness and integrity were verified using data from Downing.

The model was used to analyze the airway of a child with OSAS originally studied by Persaket al using CFD. The newly constructed model estimated a limiting flow rate of105.5 ml/s, comparable to the measured inspiration flow rates in this subject. The results demonstrate the promise of the new modeling software to efficiently simulate the effects of anatomical restriction, mechanical compliance, and driving pressure on the state of collapse and limiting flow rate in the upper airway.