Modelling CO_2 Distribution in Patient Airways using Computational Fluid Dynamics

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ABSTRACT

Computational fluid dynamics has been used to investigate the distribution of CO_2 through the upper airways of an adult and a new born infant (neonate), during natural breathing. Previously generated airway geometries and meshes obtained from CT scans of a 44 year old male and a 42 week gestational age neonate were used. 5.3% CO_2 was used to define the CO_2 concentration entering the upper airways from the lungs during expiration. Three waveforms were applied to simulate breathing, a sinusoid for each of the adult and neonate models and an additional five term Fourier series in the adult model to represent a more realistic breathing condition. The bulk of the upper airways, in both models, had relatively high CO_2 concentrations for the majority of the expiratory phase during the breathing cycle. The CFD results were obtained with a Shear Stress Transport turbulence model and validated using experimental measurements of CO_2 concentration from a physical airway model.

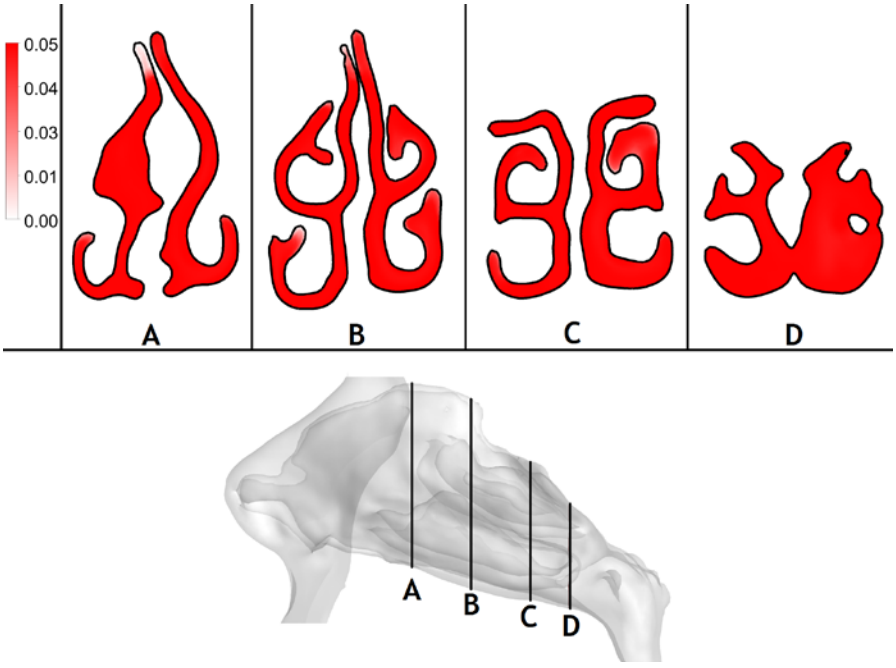

Figure **1**. Four cross-sectional slices of an adult airway showing non-dimensional CO_2 volume fraction at maximum expiration.