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COMPUTATIONAL FLUID DYNAMICS MODELING OF PULMONARY AIRFLOW PATTERNS OF *PYTHON REGIUS*

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The phylogenetic distribution and mechanisms underpinning unidirectional pulmonary airflow, in which gases pass through a portion of the lung in an identical direction during both inspiration and expiration, are poorly understood. Until recently, it was thought this pattern of flow required unique features of the avian respiratory system. Recent findings, however, show this type of airflow occurs in crocodilians and some squamates, which exhibit a whole gamut of respiratory structures distinct from those of the avian lung.

In order to further elucidate the phyletic distribution of this pattern of flow, and to elucidate mechanisms and anatomy that produce aerodynamic valves among diapsids, a mathematical model of the pulmonary system of *Python regius* was constructed using computed tomography (CT) and by segmenting regions of interest of these CT data. This model served as the domain for a computational fluid dynamics simulation of pulmonary airflow.

The Pythonidae pulmonary system is characterized by a proximal faveolar region where gas exchange occurs, as well as a distal sac-like region that is hypothesized to serve as an air reservoir and may be responsible for the bulk of respiratory airflow. Simulated pulmonary airflow in a static model exhibits cranial flow during both inspiration and expiration along the central and dorsal portion of the faveolar lung.

A dynamic model, where moving walls serve as the boundary conditions and drive airflow in and out of the lung, may provide additional information about flow during all phases of ventilation. An understanding of the type of airflow observed in the Pythonidae respiratory system and the structural features contributing to unidirectional airflow has implications for the understanding of the evolution of the vertebrate respiratory system as well the optimization of future engineered prosthetic pulmonary solutions.