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Verifying numerical predictions with experimental data is an important aspect of any modeling studies. In the case of the lung, the absence of direct in vivo flow measurements makes such verification almost impossible. We performed computational fluid dynamics (CFD) simulations in a 3D scaled-up model of an alveolated bend with rigid walls that incorporated essential geometrical characteristics of human alveolar structures and compared numerical predictions with experimental flow measurements made in the same model by particle image velocimetry (PIV). Flow in both models was representative of acinar flow during normal breathing (0.82 ml/s). The experimental model was built in silicone and silicone oil was used as the carrier fluid. Flow measurements were obtained by an ensemble averaging procedure. CFD simulation was performed with STAR-CCM+ (CD-Adapco) using a polyhedral unstructured mesh. Velocity profiles in the central duct were parabolic and no bulk convection existed between the central duct and the alveoli. Velocities inside the alveoli were 2 orders of magnitude smaller than the mean velocity in the central duct. CFD data agreed well with those obtained by PIV. In the central duct, data agreed within 1%. The maximum simulated velocity along the centerline of the model was 0.5% larger than measured experimentally. In the alveolar cavities, data agreed within 15% on average. This suggests that CFD techniques can satisfactorily predict acinar-type flow. Such a validation ensures a great degree of confidence in the accuracy of predictions made in more complex models of the alveolar region of the lung using similar CFD techniques.

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