Blood Flow Redistribution Following Pulmonary Micro-embolism

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Rationale

Occlusion of pulmonary arteries by autologous clot and bead emboli affect pulmonary function by elevating arterial pressures and reducing the number of functional gas exchange units in the lung. The occlusion of multiple arterioles at the acinar level can have a significant impact on pulmonary function. However, the contribution of acinar structure to perfusion distribution and the significance of arteriole occlusion is not well characterized.

Methods

A model of perfusion in acinar blood vessels is used to investigate blood flow redistribution, and changes in vascular resistance following arteriole occlusion. The model incorporates elastic arterioles and venules, coupled throughout the acinus by capillary sheets, providing both serial and parallel perfusion pathways. The potential impact of arteriole occlusion on pulmonary function is classified as a function of the size of occluded arteriole, the proportion of the acinus occluded and the location of the acinus within the lung.

Results and Conclusions

The structure of acinar blood vessels leads to both heterogeneity and stratification in perfusion within a single acinus as well as variation in perfusion distribution between acini in dependent and non-dependent lung regions. The acinus has the capacity for significant perfusion redistribution following the introduction of arteriole occlusions. Redistribution within the acinus should therefore be considered in addition to recruitment as a means of preventing excessive increase in pulmonary vascular resistance when arterioles are occluded.

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