

## Immediate and Chronic Changes in Regional Ventilation and Perfusion Following Unilateral Pulmonary Artery Occlusion

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It is believed that pulmonary embolism is accompanied by hypoventilation and bronchoconstriction. This concept is derived from findings obtained immediately after experimental embolization or pulmonary artery (PA) occlusion, but the duration of these effects is not known. Clinically, evidence of hypoventilation or bronchoconstriction is rarely demonstrable in embolized regions localized by perfusion lung scanning. The present study is presented to examine serially the effects of experimental pulmonary artery occlusion on regional ventilation in dogs and to find a bridge between physiologic concepts and divergent clinical experience regarding pulmonary embolism and associated airway disturbances.

Fifteen dogs were studied in serial fashion for ventilation and perfusion changes following PA occlusion either with a balloon catheter or with a rubber balloon filled with contrast medium. To assess relative ventilation, either  $^{133}\text{Xe}$  gas,  $^{99\text{m}}\text{Tc}$ -albumin aerosol or both were inhaled spontaneously through an endotracheal tube. Perfusion changes were studied by using  $^{133}\text{Xe}$  gas in saline,  $^{99\text{m}}\text{Tc}$ - or  $^{131}\text{I}$ -MAA. A scintillation camera equipped with a video-tape recording system was used for lung imaging and quantification. Hemodynamic data, cineangiography, and chest ra-

diograms were obtained. Autopsies were performed and macro- and microscopic examinations were made of lung specimens.

Relative hypoventilation with prolonged washout was found in the ischemic lung immediately and for 4-6 hours after PA occlusion. Breathing 8%  $\text{CO}_2$  improved the unilateral hypoventilation slightly. After 6-8 hours ventilation returned to normal in 80% of the dogs and remained slightly decreased in the others. After 48 hours, unless complications such as pulmonary congestion, hemorrhage, or infarction developed, normal ventilation persisted in the ischemic lung for as long as two months. However, 70% of the dogs studied for several weeks or more developed some type of pulmonary complications. The main PA and right ventricular pressures became elevated promptly after PA occlusion and remained elevated after removal of the balloon 7 days later. Angiography confirmed the perfusion lung scan findings. Normal perfusion returned following PA occlusion of 48 hours or less duration but did not return when the occlusion lasted 7 days or longer.

In conclusion, hypoventilation and bronchoconstriction occur in the ischemic lung during the first few hours following PA occlusion. They do not persist unless parenchymal pulmonary complications occur.