ESSAYS ON APS CLASSIC PAPERS

Acute hypoxia and pulmonary vasoconstriction in humans: uncovering the mechanism of the pressor response

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This essay looks at the historical significance of an APS classic paper that is freely available online:


For the lungs to operate efficiently in gas exchange, it is essential for the pulmonary blood flow to be directed to well-ventilated areas of the lungs. Teleologically, one mechanism to accomplish this end might be via nerves and pulmonary reflexogenic zones comparable to the sinus and aortic bodies in the systemic circulation. Although the lungs are richly innervated, no evidence indicates that such zones exist or that the nerves to the lungs play such a role. Instead, a mechanism for the control of the distribution of blood within the lungs is hypoxic pulmonary vasoconstriction, which automatically increases pulmonary vascular resistance in poorly aerated regions of the lungs, thereby redirecting pulmonary blood flow to regions richer in oxygen content.

A first step in uncovering the existence of hypoxic pulmonary vasoconstriction was taken by Euler and Liljestrand (6, 10). In closed-chest, spontaneously breathing cats anesthetized with chloralose, they showed that acute hypoxia elicits pulmonary vasoconstriction (Fig. 2). They postulated that hypoxic pulmonary vasoconstriction is a mechanism that sustains oxygen delivery to systemic tissues and organs by diverting pulmonary blood flow to the better aerated parts of the lungs. This demonstration, which they supplemented by observations on the effects of muscular work and vasoactive drugs on pulmonary arterial pressures, led to the conclusion that the distribution of the pulmonary blood flow within the lungs is regulated primarily by a local vasomotor mechanism that automatically directs the blood to better ventilated parts of the lungs.

Motley et al. (13), in the laboratory of André Courand (Fig. 1) at Bellevue Hospital, aware of the recent observations by Euler and Liljestrand on anesthetized cats, undertook similar observations on five normal human subjects. The subjects were rendered hypoxic by breathing an inspired gas mixture of 10% O₂ in N₂ for 10 min. In each subject, acute hypoxia elicited pulmonary vasoconstriction, as indicated by an increase in pulmonary arterial pressure. The demonstration of the hypoxic pulmonary pressor response in unanesthetized normal human subjects has three implications: 1) as in the case of the anesthetized cat, they demonstrate that the normal human pulmonary circulation responds to hypoxia by vasoconstricting; 2) they suggest that instead of simply serving as a passive conduit between the two sides of the heart, an automatic pulmonary intravascular mechanism directs venous blood...
possible effector mechanism and explains the pulmonary arterial sensor for the hypoxic pressor response in electrical terms (2, 3). Another explores the role played by endothelin as the mediator of hypoxic pulmonary vasoconstriction (1, 14). However, there is still no consensus concerning the mechanism responsible for sensing and initiating the hypoxic pulmonary pressor response.

REFERENCES


