

Radiographic Demonstration of Hypoxic Pulmonary Vasoconstriction during One-lung Ventilation

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Hypoxic pulmonary vasoconstriction occurs when the microvasculature perfusing hypoxic alveoli vasoconstricts, diverting blood to oxygenated alveoli to match ventilation with perfusion.¹ Hypoxic pulmonary vasoconstriction can occur within seconds and reach a maximum intensity within minutes of hypoxia developing. It appears to be triggered by a mitochondrial redox signal secondary to changes in molecular oxygen that activates voltage-gated potassium and calcium channels which results in vasoconstriction.² One-lung ventilation can acutely cause global alveolar hypoxia and hypoxic pulmonary vasoconstriction in the nonventilated lung. It is estimated that blood flow to a nonventilated lung can be reduced by as much as 50% if the lung is without atelectasis.³

The pulmonary angiograms were performed in a patient with a history of hemoptysis in whom a computed tomography angiogram demonstrated a pulmonary pseudoaneurysm with a presumed bronchial fistula in the right lung. The patient was scheduled for embolization with interventional radiology under general anesthesia. Because of concern for potential bleeding, lung isolation with a left-sided double

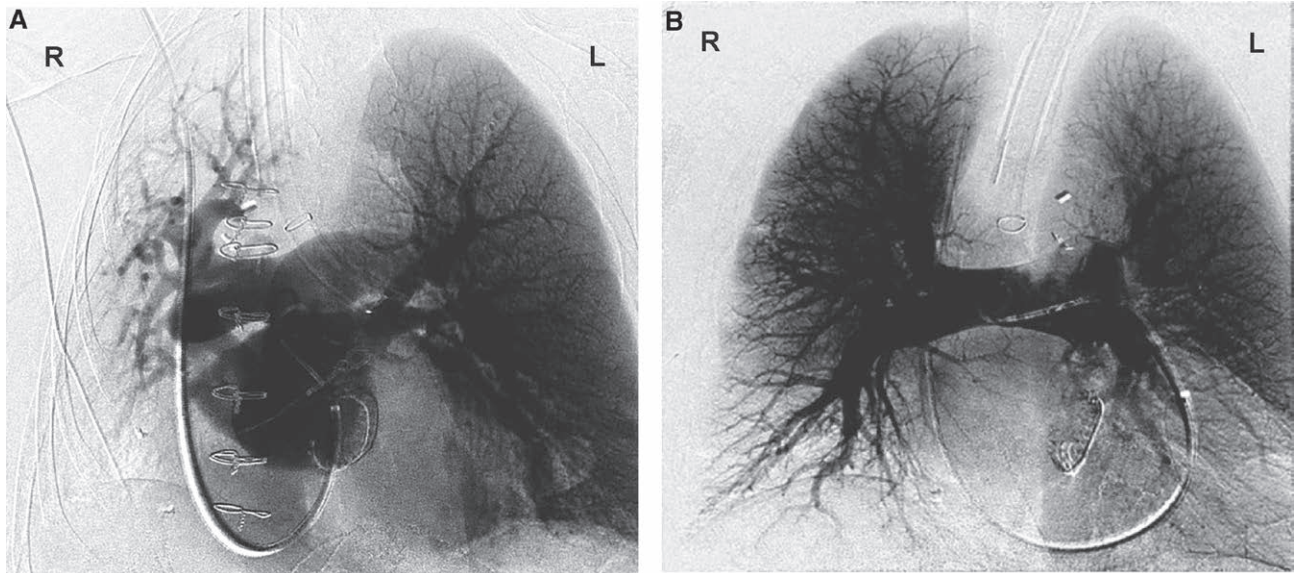
lumen tube was positioned with the right lung open to ambient pressure. Isoflurane 1.1% was used for maintenance anesthesia. After approximately 15 min of one-lung ventilation, a pulmonary angiogram was performed that dramatically revealed selective peripheral microvascular perfusion to the left lung, but almost no microvascular perfusion to the right lung (fig. panel A; Supplemental Digital Content 1, <http://links.lww.com/ALN/C912>). This limited visualization of the right pseudoaneurysm. Repeat angiogram after 5 min of two-lung ventilation restored symmetric microvascular perfusion (fig. panel B; Supplemental Digital Content 2, <http://links.lww.com/ALN/C913>). The patient subsequently underwent selective catheterization and coil embolization of the pulmonary artery pseudoaneurysm.

Competing Interests

The authors declare no competing interests.

Supplemental Digital Content

Pulmonary Angiogram during One-Lung Ventilation, <http://links.lww.com/ALN/C912>



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Pulmonary Angiogram during Two-Lung Ventilation, <http://links.lww.com/ALN/C913>

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References

1. Dunham-Snary KJ, Wu D, Sykes EA, Thakrar A, Parlow LRG, Mewburn JD, Parlow JL, Archer SL: Hypoxic pulmonary vasoconstriction: From molecular mechanisms to medicine. *Chest* 2017; 151:181–92
2. Michelakis ED, Thébaud B, Weir EK, Archer SL: Hypoxic pulmonary vasoconstriction: Redox regulation of O₂-sensitive K⁺ channels by a mitochondrial O₂-sensor in resistance artery smooth muscle cells. *J Mol Cell Cardiol* 2004; 37:1119–36
3. Lumb AB, Slinger P: Hypoxic pulmonary vasoconstriction: Physiology and anesthetic implications. *ANESTHESIOLOGY* 2015; 122:932–46