Modulation of Pulmonary Blood Flow in Patients with Acute Respiratory Failure

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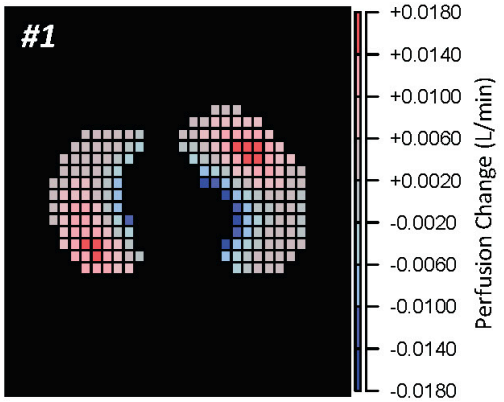
Argomento: Insufficienza respiratoria acuta e ventilazione meccanica

Background. Impairment of ventilation and perfusion (V/Q) matching is a common mechanism leading to hypoxemia in patients with acute respiratory failure requiring intensive care unit (ICU) admission. While ventilation has been thoroughly investigated, little progress has been made to monitor pulmonary perfusion at the bedside and treat impaired blood distribution. The study aimed to assess real-time changes in regional pulmonary perfusion in response to a therapeutic intervention.

Methods. Single-center prospective study that enrolled adult patients with ARDS caused by SARS-Cov-2 who were sedated, paralyzed, and mechanically ventilated. The distribution of pulmonary perfusion was assessed through electrical impedance tomography (EIT) after injecting a 10-ml bolus of hypertonic saline. The therapeutic intervention consisted of the administration of inhaled nitric oxide (iNO), as rescue therapy for refractory hypoxemia. Each patient underwent two 15-minute steps at 0 and 20 ppm iNO, respectively. At each step, respiratory, gas exchange, and hemodynamic parameters were recorded, and V/Q distribution was measured, with unchanged ventilatory settings.

Results. Ten 65 [56-75] years old patients with moderate (40%) and severe (60%) ARDS were studied 10 [4-20] days after intubation. Gas exchange improved at 20 ppm iNO (PaO2/FiO2 from 86±16 to 110±30 mmHg, p=0.001; venous admixture from 51±8 to 45±7%, p=0.0045; dead space from 29±8 to 25±6%, p=0.008). The respiratory system's elastic properties and ventilation distribution were unaltered by iNO. Hemodynamics did not change after gas initiation (cardiac output 7.6±1.9 vs. 7.7±1.9 L/min, p=0.66). The EIT pixel perfusion maps showed a variety of patterns of changes in pulmonary blood flow, whose increase positively correlated with PaO2/FiO2 increase (R2=0.50, p=0.049).

Conclusions. The assessment of lung perfusion is feasible at the bedside and blood distribution can be modulated with effects that are visualized in vivo. These findings might lay the foundations for testing new therapies to optimize regional perfusion in the lungs.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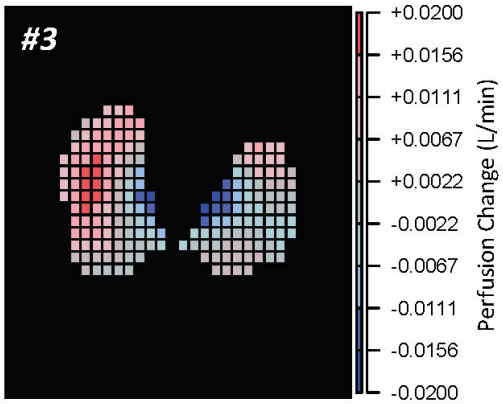
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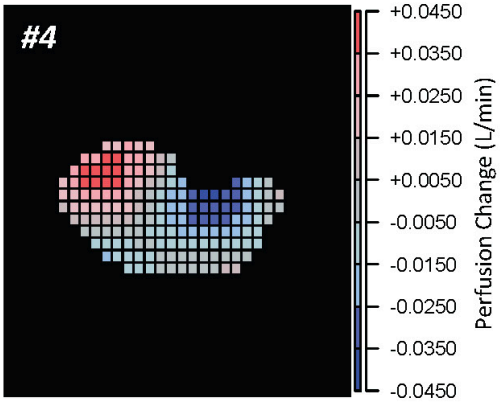
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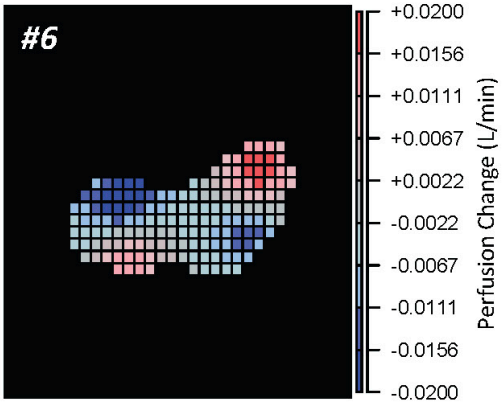
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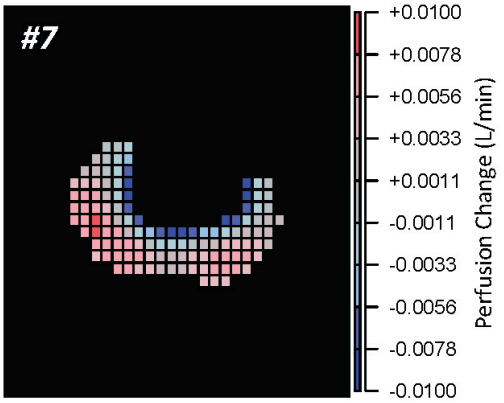
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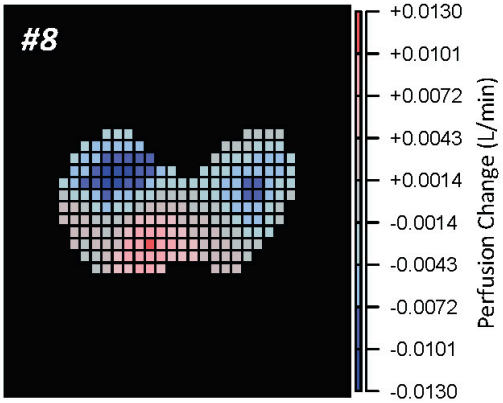
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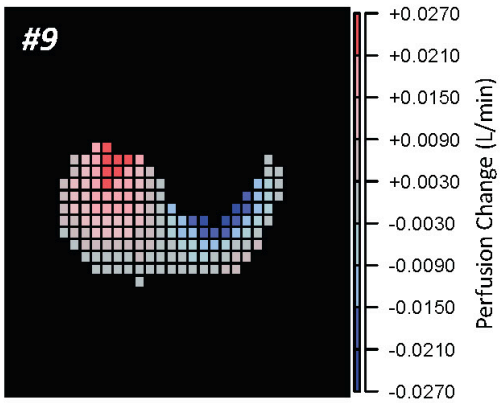
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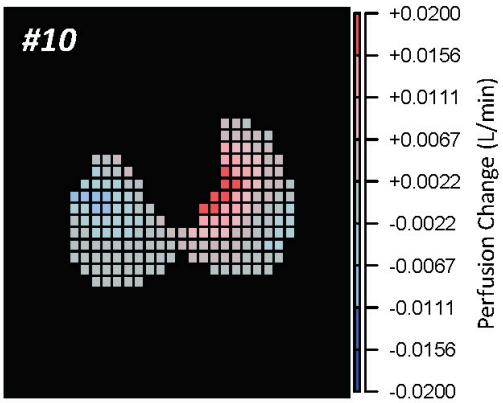
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