Immediate effects of simulated pulmonary embolism on volumetric capnography and the behavior of calculated dead space indices in a porcine model

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Argomento: VENTILAZIONE

Background: Increased alveolar dead space and ventilation/perfusion (V/Q) mismatch caused by pulmonary embolism (PE) can be monitored by volumetric capnography, It remains unclear which capnographic parameters to use. PE seems not to alter the slope of phase III in volumetric capnograms, as opposed to other diseases causing V/Q mismatch.

Hypothesis / Methods: Pulmonary embolism was induced by intermittent occlusion of the left pulmonary artery (Fogarty catheter) in 13 pigs with central V-A ECMO. Pulmonary artery pressure (PA catheter) and blood flow (ultrasonic flow probe) were measured. We analysed five volumetric capnography loops and their SI/SII/SIII slopes before and after the balloon closure and its release. Dead space calculations included Bohr's equation from blood gas analysis, Enghoff`s modification and Bohr's equation from alveolar PCO2 as determined by the midpoint of the capnographic SIII segment.

Results:Reference dead space (blood gas analysis) and the calculated dead space from the capnograms both increased significantly after induction of PE. Capnographic dead space was much lower than reference dead space. Mixed expired and alveolar CO_2 partial pressures were significantly reduced, indicating a decreased pulmonary CO_2 elimination (12 vs107 ml/min, $p<0.001$). CO_2 removal by the ECMO remained unchanged (46 vs 43 ml/min, p 0.08). The slope of S II showed a significant decrease. The S III segment demonstrated more oscillations, but the slope was not affected by the artificial PE (figure 1).

Conclusion: Simulated PE increased dead spacesignificantly and decreasedtotal CO_2 elimination The capnography, recognized, but severely underestimated the increase in dead space.. The significant decrease in slope in S II might reflect the increase in V/Q mismatch.
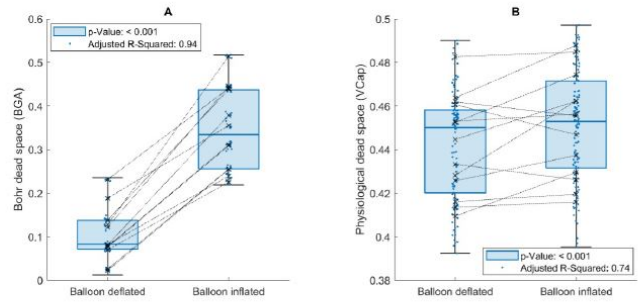
CO2 values before and after pulmonary occlusion:
A: Mean expired PCO2   B: Alveolar PCO2
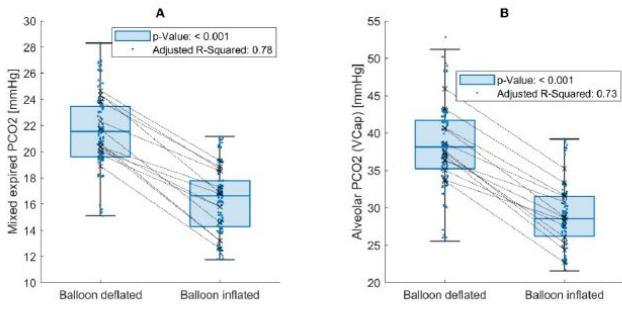
Dead space before and after pulmonary occlusion:
A: Bloodgas   B: Capnography

Volumetric capnograms and slopes (S II + S III) before and after pulmonary occlusion:
A: Before occlusion   B: After occlusion   C: Slope SII   D: Slope SIII