



Cardiac Effects of Hyperoxia During Resuscitation from Hemorrhagic Shock in Swine

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Hyperoxia (ventilation with $FIO_2 = 1.0$) has vasoconstrictor properties, in particular in the coronary vascular bed, and, hence, may promote cardiac dysfunction. However, we previously showed that hyperoxia attenuated myocardial injury during resuscitation from hemorrhage in swine with coronary artery disease. Therefore, we tested the hypothesis whether hyperoxia would also mitigate myocardial injury and improve heart function in the absence of chronic cardiovascular co-morbidity. After 3 hours of hemorrhage (removal of 30% of the calculated blood volume and subsequent titration of mean arterial pressure to 40 mmHg) 19 anesthetized, mechanically ventilated and instrumented pigs received $FIO_2 = 0.3$ (control) or hyperoxia ($FIO_2 = 1.0$) during the first 24 hours. Before, at the end of and every 12 hours after shock, hemodynamics, blood gases, metabolism, cytokines and cardiac function (pulmonary artery thermodilution, left ventricular pressure-conductance catheterization) were recorded. At 48 hours, cardiac tissue was harvested for western blotting, immunohistochemistry and mitochondrial respiration. Except for higher left ventricular end-diastolic pressures at 24 hours (hyperoxia 21(17;24), control 17(15;18) mmHg; $p = 0.046$), hyperoxia affected neither left ventricular function cardiac injury (max. Troponin I at 12 hours: hyperoxia: 9(6;23), control: 17(11;24) ng mL; $p = 0.395$), nor plasma cytokines (except for interleukin-1 β : hyperoxia 10(10;10) and 10(10;10)/control 14(10;22), 12(10;15) pg mL, $p = 0.023$ and 0.021 at 12 and 24 hours, respectively), oxidation and nitrosative stress, and mitochondrial respiration. However, hyperoxia decreased cardiac tissue 3-nitrotyrosine formation ($p < 0.001$) and inducible nitric oxide synthase expression ($p = 0.016$). Ultimately, survival did not differ significantly either. In conclusion, in contrast to our previous study in swine with coronary artery disease, hyperoxia did not beneficially affect cardiac function or tissue injury in healthy swine, but was devoid of deleterious side effects.

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