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Increased ileal-mucosal-arterial PCO_2 gap is associated with impaired villus microcirculation in endotoxic pigs

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Abstract:
Abstract. Objective: To investigate whether an increased ileal-mucosal-arterial PCO_2 gap ((PCO_2) during hyperdynamic porcine endotoxemia is associated with impaired villus microcirculation. Design: Prospective, randomized, controlled, experimental study. Setting: Animal research laboratory. Animals: Twenty-two domestic pigs. Interventions: After baseline measurements, anesthetized and ventilated pigs received continuous i.v. endotoxin (ETX, n=12) for 24 h or placebo (SHAM, n=10). Measurements and results: Before, as well as 12 and 24 h after, the start of endotoxin or saline portal venous blood flow (Q_{PV}, ultrasound flow probe) and lactate/pyruvate ratios (L/P), the ileal-mucosal-arterial (PCO_2 (fiberoptic sensor) and bowel-wall capillary hemoglobin O_2 saturation (%Hb-O_2-cap, remission spectrophotometry) were assessed together with intravital video records of the ileal-mucosal microcirculation (number of perfused/heterogeneously perfused/unperfused villi) using orthogonal polarization spectral imaging (CYTOSCAN A/R) via an ileostomy. At 12 and 24 h endotoxin infusion, about half of the evaluated villi were heterogeneously or unperfused which was paralleled by a progressive significant increase of the ileal-mucosal-arterial (PCO_2 and portal venous L/P ratios, whereas Q_{PV} as well as both the mean %Hb-O_2-cap and the %Hb-O_2-cap frequency distributions remained unchanged. By contrast, in the SHAM-group, mucosal microcirculation was well-preserved, and none of the other parameters were influenced. Conclusions: We conclude that an increased ileal-mucosal-arterial (PCO_2 during porcine endotoxemia is related to impaired villus microcirculation. A putative contribution of disturbed cellular oxygen utilization resulting from "cytopathic hypoxia" may also assume importance.

Keywords:
Endotoxin, Ileal-mucosal-arterial PCO 2 gap, Orthogonal polarization spectral imaging, Lactate/pyruvate ratios, Remission spectrophotometry, Villus microcirculation