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SIMULTANEOUS, ENDOSCOPIC MEASUREMENT OF MICROVASCULAR OXYGEN SATURATION AND LASER- DOPPLER FLOW IN GASTRIC MUCOSA

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Objective of Study: To evaluate the feasibility of simultaneous endoscopic measurement of microvascular oxygen saturation (μHbO_2) and laser-Doppler flow (LDF) in gastric mucosa.

Theoretical Background: Attenuation of μHbO_2 of gastric mucosa due to the application of positive end-expiratory pressure (PEEP) has been reported in the animal experiment. The effect of PEEP on μHbO_2 could be separated from the impact of PEEP on systemic circulation, because normalization of cardiac output, depressed due to reduced preload by PEEP, did not restore μHbO_2 as well[1]. To further elucidate the mechanism for this obvious differential action on systemic and regional perfusion we sought for a method to simultaneously measure the impact of PEEP on gastric mucosal blood flow and μHbO_2.

Methods: A highly flexible probe was designed which combines the properties of μHbO_2 and relative hemoglobin concentration (rel.Hb-con.) measurements by tissue lightguide spectrophotometry and the ability to assess mucosal blood flow by laser-Doppler flowmetry (LEA Medizintechnik GmbH, Gießen, Germany). After local ethic committee approval 4 volunteers were included in this pilot study. The probe was positioned through a nasogastric tube into the stomach of the volunteers. After assessing baseline values with zero end-expiratory pressure (ZEEP) the volunteers were assigned to nasal CPAP (continuous positive airway pressure) breathing with 5 and 10 cmH_2O PEEP in random order.

Results: The median (range) for μHbO_2 of gastric mucosa during ZEEP was 59% (50% to 70%) and dropped to 52% (40% to 63%) and 44% (30% to 50%) during 5 respectively 10 cmH_2O PEEP, increasing to 60% (50% to 75%) after returning to ZEEP. rel.Hb-con. was unchanged during PEEP and increased after returning to ZEEP. LDF increased in 3 individuals during PEEP.

Conclusions: This primary study shows that the developed probe can be used to monitor μHbO_2, rel.Hb-con., and LDF of gastric mucosa endoscopially. The capability to measure these variables simultaneously using only one probe represents a novel approach to monitor online the microcirculation, and therefore bears the potential to provide us with new insights into pathophysiological alterations.

References:

1. Fournell A, Scheeren TWL, Schwarte LA: PEEP decreases oxygenation of the intestinal mucosa despite normalization of cardiac output. Adv Exp Med Biol 1998; 454: 435 - 40