0597. The relation between intestinal intramucosal pH and stress hormones in pig hemorrhagic shock model

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Introduction
It is known that intestinal intramucosal pH (pHi) is a good parameter of tissue perfusion in critical patients. However, physiological meaning of pH value related to other physiological parameter, such as stress hormone, is not well known. The purpose of the study is to clarify the importance of monitoring pH during hemorrhagic shock in pig model. The relation between pH, oxygen supply and demand balance at intestinal region and stress hormones are discussed.

Methods
The studies were performed on 6 pigs (body weight 25 ± 4 kg). Anesthesia was induced by inhalation of isoflurane 3-5% and after endotracheal intubation, pigs were placed on a positive pressure ventilation. Anesthesia was maintained with pancuronium and isoflurane 2%. A catheter was inserted through carotid artery to measure aortic blood pressure and to sample blood. Ringer’s Lactated solution was infused throughout the experiment at 10 ml/kg/hr. The pig’s abdomen was opened through a midline incision and the electromagnetic flow probe was placed on the root of superior mesenteric artery (SMA). Tonomitor® (Tonometrics) was inserted from antimesenteric region of jejunum. A polyvinyl tube was inserted to superior mesenteric vein (SMV) to sample blood.

Protocol: Control data were obtained after 30 min stabilization period (Baseline; S1). Then the pigs were bled gradually and MAP was maintained at 40mmHg for 1 hours (Shock Phase; S2). Pigs were resuscitated with whole blood (Resuscitation Phase 1; S3). Additional 1 hour was evaluated for post-resuscitation phase (S4).

Measurements: Jejunal pH was calculated by the luminal PCO2, obtained with a balloon tonometer, and arterial bicarbonate concentration. Arterial blood samples were taken for analysis of adrenaline (ADR), noradrenaline (NA), angiotensin II (Ang II) and arterial blood gas. SMV blood samples were taken for analysis of lactate/pyvlate acid (sma L/P), and blood gas (PsmvCO2).

Results
At shock phase, SMA flow decreased to 40% from the baseline (p < 0.01) and pH decreased from 7.4 ± 0.2 to

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6.8 ± 0.2 (p < 0.01). The correlation between pH and other parameters are as follows, pH vs PsmvCO2; y = -0.02x + 8.22 (r² = 0.72) (Fig 1), pH vs smv L/P; y = -0.02x + 7.64 (r² = 0.76) (Fig 2), pH vs ADR (pg/ml); y = -0.09ln(x) + 7.74 (r² = 0.72), pH vs NA (pg/ml); y = -0.09ln(x) + 7.79 (r² = 0.74), pH vs Ang II (pg/ml); y = -0.11ln(x) + 7.71 (r² = 0.75).

Discussion
Changes of pH value during hemorrhagic shock was correlated with PsmvCO2, smv L/P and stress hormones (ADR, NA, Ang II). It is considered that change in pH show the anaerobic metabolism status of the intestinal tissue which indicate tissue hypoxia of the intestine induced by hemorrhagic shock and increase in sympathetic nerve activity. pH was strongly correlated to other physiological parameters which indicate that pH is significance parameter of hemorrhagic shock.

Conclusions
pH is significant parameter of tissue hypoperfusion and sympathetic nerve activity during hemorrhagic shock.

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