The Effects of Haemorrhage and Phenylephrine on the Porcine Gut Mucosal Microcirculation

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Introduction

- A natural compensatory mechanism to haemorrhage is selective vasoconstriction to maintain perfusion of vital organs.

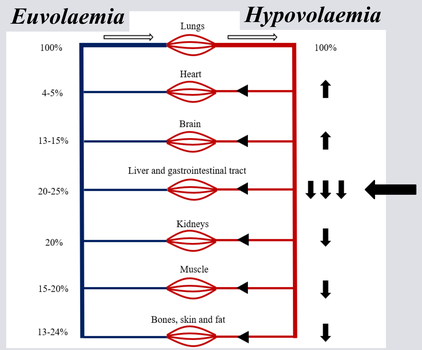

***Figure 1*. Changes in blood flow to individual organs during euvolaemia and hypovolaemia (1).**

- Gut microcirculatory hypoperfusion is therefore an early consequence of haemorrhage (2,3). Perioperative gut ischaemia is associated with increased patient mortality (4).
- Vasopressors are often given as a pharmacological intervention to restore mean arterial pressure and thus perfusion of the vital organs.

Aims

- To investigate the effects of incremental haemorrhage and phenylephrine administration on gut mucosal microcirculation and systemic haemodynamic variables.

Methods

- 6 anaesthetised pigs were bled in stages relating to an estimation of 5%, 10%, 15% and 20% of total blood volume (HMR stages). The blood was then re-transfused (stage BC) and crystalloid fluids given (stage BD).
- PE was infused after baseline and following each haemorrhage stage (VC stages).
- Gut mucosal microcirculation was assessed using sidestream dark-field imaging of the small intestine. The video clips were scored; a higher score indicated superior blood flow.
- A range of haemodynamic variables were measured at baseline (BA) and following each stage of the procedure.

Results

The effects of haemorrhage:

- Gut microcirculation scores decreased with haemorrhage.
- Hypotension prediction index (HPI) demonstrated a fast and consistent response to haemorrhage.

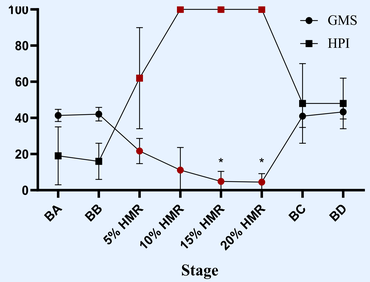

***Figure 2*. The effect of haemorrhage on gut microcirculation scores (GMS) and HPI.** *HMR stages shown in red. *significant (p<0.05) difference from BA.*

The effects of PE during haemorrhage:

- Most variables did not differ significantly from baseline following PE administration at all haemorrhage levels.

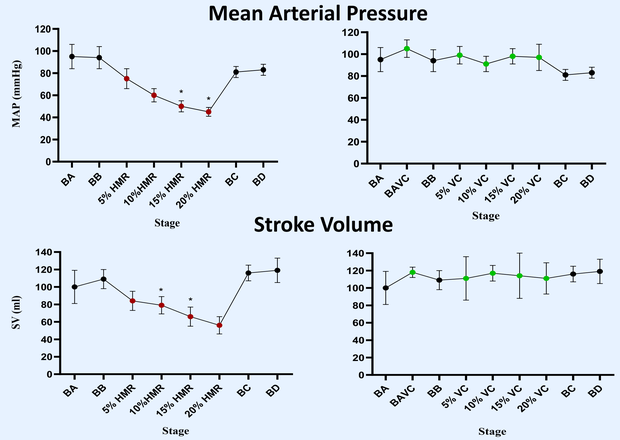

***Figure 3*. The effects of haemorrhage alone (left graphs) and haemorrhage with PE present (right graphs) on mean arterial pressure (MAP) and stroke volume (SV).** **significant (p<0.05) difference from BA. HMR stages shown in red. VC stages shown in green.*

- Gut microcirculation scores did not change significantly before and after PE administration at all haemorrhage levels.

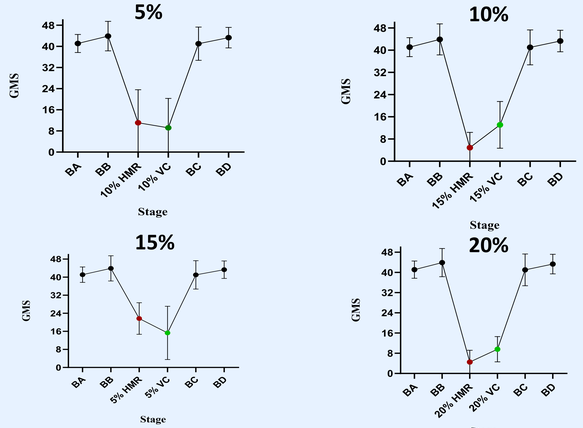

***Figure 4.* Graphs showing GMS before and after PE administration at each percentage haemorrhage**. *HMR stages shown in red. VC stages shown in green.*

Conclusions

- Gut microcirculation deteriorated from the early stages of haemorrhage.
- The majority of haemodynamic variables failed to reflect this gut hypoperfusion or intravascular deficit.
- PE rapidly restored systemic haemodynamic variables but gut microcirculatory disturbances persisted, emphasising the shortcomings of these commonly used variables.
- A clinically applicable method of determining any dissociation between systemic haemodynamics and the microcirculation would be invaluable in guiding appropriate, early intervention choices.

References

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