

Regional Tissue Oxygen Saturation in an Animal Model of Global and Regional Oxygen Delivery Insults

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Introduction:

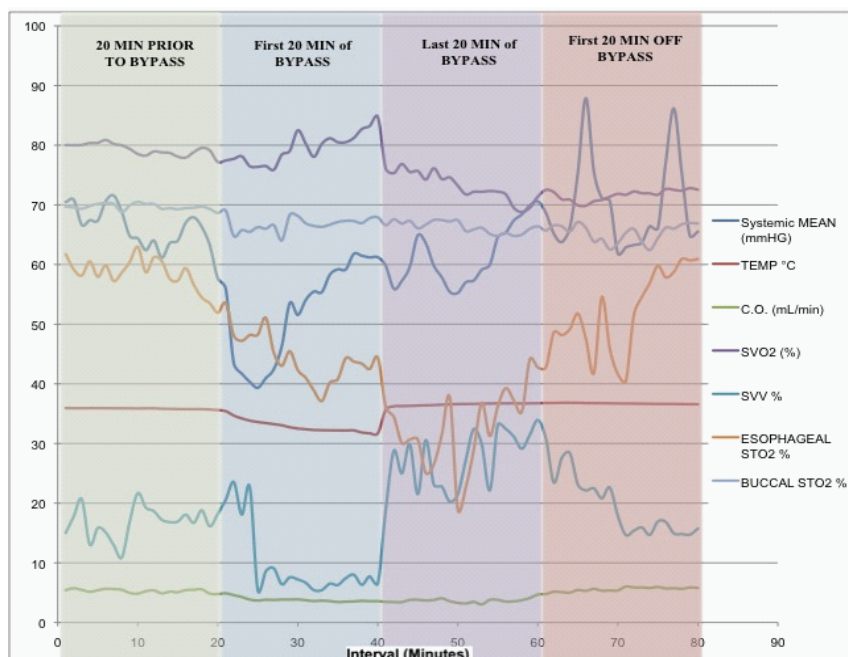
Splanchnic oxygen delivery abnormalities may occur in patients with critical illness and have been associated with a range of morbidities. The ability to assess oxygen delivery to an organ system supplied by the splanchnic circulation may provide a more sensitive mode to detect critical disease states compared to systemic measures such as mixed venous saturation (ScVO₂), lactate, HR, UOP, BP, or CVP. This study evaluates correlation between regional mucosal oxygen saturation (StO₂) by visible light spectroscopy (VLS) and tissue near infrared spectroscopy (NIRS) during regional insults involving graded mesenteric flow decrease or global hypoxia in a neonatal lamb model.

Methods:

This was a sequential descriptive observational study in 5 anesthetized mechanically ventilated lambs. StO₂ was measured from buccal and esophageal mucosa, with the latter positioned at the level of the diaphragm. NIRS regional oximetry (SrO₂) was measured from a somatic skin sensor over the kidney. A transonic flow probe was surgically placed on the first mesenteric artery branching from the aorta below the diaphragm. Regional insult was produced by occlusion of the descending aorta below the subclavian artery, but above the diaphragm to achieve 50, 75, or 100% reductions in mesenteric artery blood flow. Global hypoxic insult was produced by decreasing inspired oxygen to 10%. Data were analyzed by Pearson correlation and linear regression between mesenteric flow and regional StO₂, ScVO₂, and flank NIRS values.

Results:

Esophageal StO₂ was directly proportional to mesenteric arterial flow ($r^2=0.72$; $p<0.001$) during regional flow occlusion and restoration. Significant positive correlation was also observed between buccal StO₂ values and ScVO₂ ($r^2 = 0.3$; $p<0.001$). However, this correlation was stronger during the global hypoxic insult ($r^2 =0.77$; $p<0.001$) than the regional occlusive insult ($r^2 =0.3$; $p<0.001$). In addition, esophageal StO₂ was the earliest marker for decreased tissue oxygenation during both hypoxic and regional blood flow insults. NIRS SrSO₂ did not correlate with mesenteric flow or ScVO₂.



| PEARSON CORRELATION 20 MIN BEFORE / AFTER CPB | | | | | |
|---|------------------------|--------------------|------------------|---------------|------------|
| | ESOPHAGEAL STO2 (%) | BUCCAL STO2 (%) | C.O. (ml/min) | SVO2 (%) | SVV (%) |
| ESOPHAGEAL STO2 (%) | | 0.604 | 0.074 | 0.594 | -0.539 |
| BUCCAL STO2 (%) | 0.604 | | -0.351 | 0.889 | -0.269 |
| C.O. (ml/min) | 0.074 | -0.351 | | -0.269 | -0.477 |
| SVO2 (%) | 0.594 | 0.889 | -0.269 | | -0.430 |
| SVV (%) | -0.539 | -0.269 | -0.477 | -0.430 | |
| Systemic MEAN (mmHG) | -0.036 | -0.195 | 0.279 | -0.295 | 0.043 |
| TEMP (°C) | -0.569 | -0.869 | 0.343 | -0.950 | 0.414 |

Discussion:

Our results indicate that type of insult (regional vs. global) has differing effects on both commonly used systemic measures and the newer regional oximetry devices. Esophageal StO2 was the only monitor to correlate with changes in mesenteric flow. Our results also suggest buccal StO2 is a potential surrogate for ScVO2. These results support the need for further investigation of regional VLS oximetry devices.

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Summary:

Correlation was observed between esophageal mucosal oxygen saturation and decreases in regional blood flow and between buccal mucosal oxygen saturation and ScVO2 in this animal model.