Correlation of Buccal Mucosal Oxygenation to Venous Oxygen Saturation During Cardiopulmonary Bypass -- A Non-Invasive Way to Estimate Total Body Oxygen Extraction

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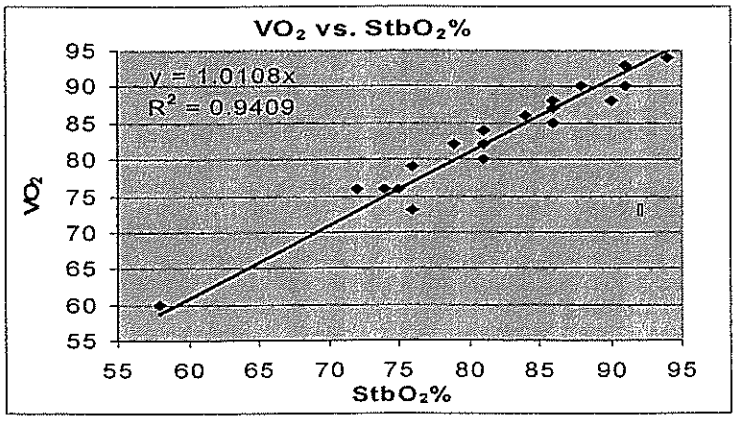
Background: A new device that continuously measures buccal mucosal oxygenation (St_bO_2%) via visible light spectroscopy (VLS) has shown promise as an alternative to the conventional pulse oximeter during cardiopulmonary bypass (CPB) where flow is non-pulsatile.[1,2] In this study, we compared data from this device to venous saturation obtained from CPB.

Method: A non-invasive buccal-clip probe was inserted after induction of anesthesia in 6 randomly selected patients undergoing cardiac surgery with cardiopulmonary bypass. The probe measured mucosal tissue oxygenation (St_bO_2%) and hemoglobin by continuously emitting and analyzing low power, broadband, visible light after it passes through tissue. Data was recorded every 0.2S. Venous saturation (VO_2) was periodically measured on samples obtained from the CPB circuit and correlated to the simultaneous St_bO_2% values. Data from all patients (20 data points) were pooled, VO_2 plotted against St_bO_2%. Least-square regression was used to calculate the trendline and y-incercept placed at 0.

Results: As shown in Figure 1, the VO_2 correlated with the St_bO_2% measured by the VLS oximeter with a slope of 1.0 and least-square variance (R^2) of 0.94.



Discussion: The oxygen extraction by total body tissue is proportional to the difference between the arterial and venous O_2 saturation (SaO_2 and VO_2, respectively). The result of this study shows that during CPB, the venous saturation can be approximated by the buccal mucosal oxygenation (R^2=0.94), which is equivalent to the end capillary oxygenation. Since the SaO2 is kept at 100% on CPB, the total body oxygen extraction ratio can be estimated as:

$$ER\_O_2 = (SaO_2 - VO_2) / SaO2 = 1 - St_bO_2\%$$

The use of the VLS device can thus provide a simple method to directly estimate tissue oxygen extraction during CPB, allowing better monitoring of tissue perfusion. The VLS oxymer is non-invasive, simple-to-use, and acquires accurate, continuous data as compared to the PA catheter. These characteristics gives it the potential to become the monitor of choice for patients undergoing CPB and in situations where the conventional oxymeter does not work (e.g. cold patient).

References:

1. Benaron et al. Anesthesiology 2004. In press.
2. Van der Starre et al. Manuscript in submission, 2004.