Title :TRANSCONJUNCTIVAL OXYMETRY IN THE CRITICALLY ILL ADULT PATIENT

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INTRODUCTION: Maintaining adequate oxygen supply to vital organs and tissues is quite important in caring for the critically ill patient. The non-invasive technique of measuring transcutaneous oxygen tension preports to afford arterial oxygen measurments at a peripheral vascular bed. However, the technique suffers from errors induced from high transcutaneous oxygen diffusion gradients and artifacts induced from high thermal heating required to maintain 'arterialization'. Good results are obtained only in neonates and healthy homeostatic adults. (1) Improvement in non-invasive oxygen measuring can be made if a more advantageous peripheral vascular bed is used. The palpebral conjunctiva is an easily accessable capillary bed not covered by a thick layer of oxygen-consuming tissue, inherently displays a low oxygen diffusion gradient since its usual function is to supply oxygen to the cornea, and requires no supplemental heat for 'arterialization'. An oxygen sensor placed between the sclera and the palpebral conjunctiva is exposed to near arterial oxygen tension. A polarographic technique using a Clark electrode with a platinum cathode and a silver anode can be miniaturized for this application. (2,3) Because both the Clark electrode reaction rate and the oxy-hemoglobin dissociation curve are temperature dependent, significant error is introduced with temperature changes of the electrode and conjunctiva. Measuring the local temperature with a thermistor allows some error correction. The miniaturized Clark electrode and thermistor are implanted in a conformer ring which maintains them in direct contact with the tarsal portion of the palpebral conjunctiva.

METHODS: Fourteen patients with informed consent and institutional approval were studied at the Stanford University Hopsital. A radial intra-arterial line was placed in each patient. The transconjunctival sensor was inserted in the right eye, the eyelids closed, but not taped shut. The FiO2 for each patient was altered during the study. When the transconjunctival sensor readings appeared stable, a heparinized arterial blood gas sample was drawn, immediately placed in ice, and analyzed in a Corning 168 analyzer within ninety minutes. A normal oxy-hemoglobin dissociation curve for each patient was assumed and was justified in that all patients were relatively healthy acute patients. Corrections in oxygen tensions for deviations from 37 C were made using the nomagram of Severingshaus.

RESULTS: Transconjunctival values trend well with arterial values, but read consistenly lower. A multilinear regression analysis was performed on each sample case and on the pooled data. Correlation of transconjunctival oxygen tension(PcjO2) versus arterial oxygen tension(PaO2) varied from .27 to .93 for individual cases. For the pooled data, the correlation was .75 for 180 samples with an intercept of 120.8 mmHg and the standard error of the estimate was 54.7 mmHg(Figure 1). A P value of <.0005 for the pooled data was calculated using Student's t test.

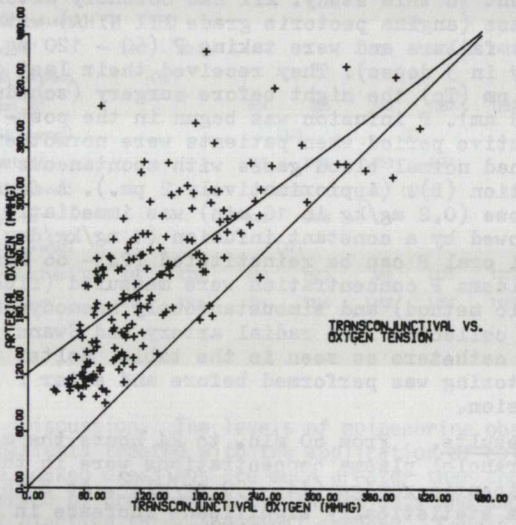

FIGURE 1

Eye exam results showed that no patient suffered any eye damage except for mild hyperemia or chemosis.

DISCUSSION: The transconjunctival oxygen sensor is the least disruptive peripheral vascular bed monitor yet developed for clinical monitoring. Because the technique is not dependent on supplemental heat, changes in peripheral vascular tone, perfusion, and oxygen delivery are not disrupted. The transconjunctival oxymeter values are consistently lower than arterial values and are effective in reflecting trends in arterial oxygenation to the vascular bed. Correlation with arterial oxygen tension levels is good provided peripheral tissue perfusion is not compromised.

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