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Title: DOES FIBEROPTIC BUNDLE DESIGN AFFECT THE CLINICAL ACCURACY OF MIXED-VENOUS OXYGEN SATURATION CATHETERS?

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Introduction: Fiberoptic bundles incorporated into pulmonary artery catheters offer a continuous monitor of mixed venous oxygen saturation which has been demonstrated to reflect mixed venous oxygenation as measured by co-oximetry (1). Systems previously studied employ spectrophotometric analysis via two fiberoptic bundles (Oximetrix catheter, Abbott Critical Care Systems, Mountain View, CA, "O"). A new triple fiber design is intended to increase measurement accuracy (Spectracath, Viggo-Spectramed, Oxnard, CA "S"). We performed a prospective study which compares these catheters in cardiac surgery patients.
Methods: After approval by the Institutional Review Board and obtaining informed consent, 40 patients undergoing valve replacement, coronary surgery, or combined procedures were randomized to receive either an O or S catheter. The catheters were pre-calibrated in vitro. Catheters were compared for difficulty of insertion and for the accuracy of the preinsertion calibration. Then catheter SvO2 measurements were compared to mixed venous blood gas measurements performed on an IL 1312 blood gas analyzer at six time points: pre-bypass, post-bypass, during weaning to 0.8 and 0.6 FiO2, and at 8 and 18 hours post-bypass. Measurements of hemodynamic indices, hemoglobin, and core temperature were made. Statistical analysis for the SvO2 accuracy was by linear regression, Chi square for catheter whip rate, and Student's t-test for comparison of patient demographics, accuracy versus time, and comparison of regression analyses.
Results: The two groups of patients were comparable in their demographics, the procedures performed, and baseline hemodynamics. All of the catheters could be inserted in 3 or fewer attempts, and 1 of 20 catheters of each type could not be wedged. The mixed venous oxygen saturations measured by both catheters reflected the saturation as measured by co-oximetry. There were no significant differences between the catheters in the regression of co-oximeter SvO2 vs catheter SvO2. For neither catheter were there any effects on accuracy by varying hemoglobin (6-14.5 gm/dl), cardiac output (2-10 l/min) or temperature (34-38.5°C). The S catheter had 3 of 20 fail due to breakage of the optics versus none of the O catheters ($p<0.05$). In 8 of 20 S catheters, the PA tracing was complicated by catheter whip, which was significantly greater than the O catheter, 2/20 ($p<0.05$). The preinsertion calibration of the O catheter was less accurate than that for the S catheter ($p<0.05$). After recalibration, the catheters were only significantly different at the pre- and post-bypass time points.
Discussion: Both catheters in this study provided real-time SvO2 measurements which correlated to that measured by co-oximetry with coefficients similar to those reported previously (1). The additional fiberoptic cable incorporated into the S catheter has not improved the accuracy over that of the O catheter. Neither catheter posed difficulty with insertion. The O catheter precalibration was less accurate, but the S catheter had a higher rate of catheter failure and a higher rate of confusing PA tracings which may make this catheter less suitable for critical care applications.
Reference: 1. J Cardiothorac Anes 1988; 2:440.

Table 1: SvO2 Deviation (Oximetrix vs Spectracath)

Catheter	T0	T1	T2	T3	T4	T5	T6
O Mean	5.9	-2.8	0.5	-0.7	0.03	-1.4	-3.5
SEM	1.1	1.1	1.2	1.3	1.5	1.5	0.8
S Mean	1.6	1.8	4.6	0.7	1.8	2.8	-0.6
SEM	1.5	1.2	1.0	1.0	0.9	1.3	1.1
p	<0.05	<0.05	<0.05	NS	NS	NS	NS

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Title: **NONINVASIVE MONITORING OF MIXED VENOUS OXYGEN SATURATION (S_vO_2) IN INFANTS BY NEAR INFRARED REFLECTANCE SPECTROSCOPY (NIRS)**

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Introduction: As an optical method that noninvasively measures microvascular hemoglobin saturation ($tHbO_2$%), NIRS offers the prospect of monitoring tissue oxygen stores, even in infants. Changes in $tHbO_2$ reflect the oxygen supply/demand relationship in tissue Therefore we sought to determine the relationship of two means of estimating systemic perfusion, $tHbO_2$ as assessed in muscle and systemic mixed venous oxygen saturation (S_vO_2) in infants undergoing open heart surgery.
Methods: After IRB approval, we studied 8 term infants aged 3-39 days. They were anesthetized with fentanyl and pancuronium, and managed by our standard clinical protocol. S_vO_2 was measured by oximetry of the blood passing through the venous return line of the cardio-pulmonary bypass (CPB) circuit. $tHbO_2$ was measured on the anterior thigh by a dual wavelength (760 and 800 nm) NIRS probe. Differences in the absorbance of light at 760 nm with respect to 800 nm ($\Delta OD_{760-800}$)reflect changes in $tHbO_2$. As the metabolic needs were altered by anesthesia and cooling on CPB, S_vO_2 varied from 68-98% and $OD_{760-800}$ was continuously recorded.
Results: As shown in figure 1, S_vO_2 was linearly related to $\Delta OD_{760-800}$. S_vO_2 varied from 68-98% as body temperature and CPB flow were changed, and $\Delta tHbO_2$ was continuously recorded.
Discussion: The linear relationship between ΔS_vO_2 and muscle $\Delta tHbO_2$ suggests that NIRS monitoring of an extremity provides information about global oxygen supply/demand relationship. Because $tHbO_2$ changed even while S_vO_2 was high, muscle may be a more sensitive indicator of changes in O_2 supply/demand than vital organs such as brain, where the magnitude of change in the tHbO2 during similar changes might be reduced by autoregulation. This technique might prove useful in monitoring therapeutic interventions in shock states in young infants.

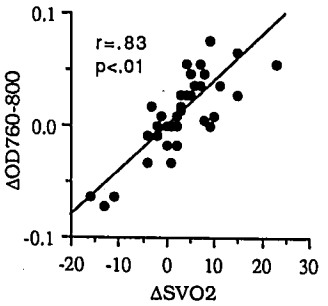

fig 1. Relationship of changes in mixed venous oxygen saturation to ΔOD760-800 measured at the leg.