CO-Oximetric Measurement of Left Innominate Vein Oxygen Saturation During Hypoxemia in Volunteers

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Background/Introduction: We previously used a noninvasive optoacoustic (OA) technique in volunteers to measure oxygen saturation (SO$_2$) in the left innominate vein (LIV), which joins the right innominate vein to form the superior vena cava (1). OA monitoring of SO$_2$ in the LIV (SLIVO$_2$) may represent a rapid, convenient method for assessing central venous SO$_2$ in patients in shock. In that study, progressive lower body negative pressure (LBNP) was associated with relatively well maintained SLIVO$_2$ until abrupt hypotension occurred, necessitating immediate termination of LBNP before measurements could be obtained. We hypothesized that graded hypoxemia, used by others to evaluate pulse oximeters (2), would produce stable reductions in SLIVO$_2$ measured by CO-Oximetry.

Methods: In a protocol approved by the institutional review board, LIV catheters were placed in 12 healthy volunteers. Pulse oximetry (SpO$_2$), noninvasive blood pressure and ECG monitoring were monitored. Through a snug face mask, FiO$_2$ was changed in the following sequence: 0.21, 0.08, 0.18, 0.09, 0.17, 0.10, 0.16, 0.11, 0.15, 0.12, 0.21. After SpO$_2$ had stabilized at each FiO$_2$, two blood samples were drawn at one-minute intervals and SLIVO$_2$ was immediately measured using a clinical CO-Oximeter. At study conclusion the LIV catheter was withdrawn. Two of 12 subjects became sufficiently uncomfortable that they did not complete the study sequence. SLIVO$_2$ and SpO$_2$ were correlated using the coefficient of determination ($R^2$).

Results: Because two subjects could not complete the protocol, the total number of measurements of SLIVO$_2$ and SpO$_2$ was 237. Decreases in SLIVO$_2$ correlated well with decreases in SpO$_2$ ($R^2 = 0.65$) (Figure).

Conclusion: In volunteers, graded hypoxemia produces stable, highly correlated decreases in SLIVO$_2$. Graded hypoxemia represents a suitable protocol for comparing hemoximetric measurements to optoacoustic measurements of SLIVO$_2$.