INTRODUCTION

Mixed venous saturation (ScvO2) has been widely studied and accepted as a marker of global tissue perfusion in cardiac surgery patients both in the operating room (OR) and the intensive care unit (ICU). However, measurement of ScvO2 requires the placement of a pulmonary artery (PA) catheter, which is highly invasive and not feasible in certain patient populations, especially children. Central venous saturation (SvO2), which can be obtained from a central venous catheter (CVC), has been studied as a surrogate to ScvO2. While there has been debate over the correlation between SvO2 and ScvO2, it has been clearly shown that ScvO2 is superior to vital signs alone for assessing global perfusion. Unfortunately, very little literature exists on the use of SvO2 in children. Continuous ScvO2 measurement for pediatric patients is under development and warrants study. We determined the accuracy of a pediatric CVC with integrated fiberoptic oximetry, correlated the readings with hemodynamics in anesthetized pigs, and tested its feasibility in pediatric patients undergoing open cardiac surgery.

METHODS

A CVC capable of continuous ScvO2 monitoring by infrared oximetry (pediSat© oximetry catheter, Edwards Lifesciences, shown in Figure 1) was placed in 5 anesthetized pigs (experimental protocol). Cardiac index (CI), heart rate (HR), mean arterial pressure (MAP), mean pulmonary artery pressure (MPAP), central venous pressure (CVP), inspired oxygen concentration (FIO2), arterial oxygen saturation by pulse oximetry (SaO2), were also measured at these times. Correlation of inspired oxygen concentration (FIO2), arterial oxygen saturation (SaO2), cardiac index (CI), mean pulmonary artery pressure (MPAP), central venous pressure (CVP), and not feasible in certain patient populations, especially children. Central venous saturation (SvO2), which can be obtained from a central venous catheter (CVC), has been studied as a surrogate to ScvO2. While there has been debate over the correlation between SvO2 and ScvO2, it has been clearly shown that ScvO2 is superior to vital signs alone for assessing global perfusion. Unfortunately, very little literature exists on the use of SvO2 in children. Continuous ScvO2 measurement for pediatric patients is under development and warrants study. We determined the accuracy of a pediatric CVC with integrated fiberoptic oximetry, correlated the readings with hemodynamics in anesthetized pigs, and tested its feasibility in pediatric patients undergoing open cardiac surgery.

RESULTS

There were no catheter-related complications. Experimental hemodynamic, oximetric, and laboratory data is shown in Table 1. There was a significant correlation between SvO2 and MPAP and PaO2 (r=0.52, p<0.001) and increase in MAP, HR, and Esophageal Doppler (ED) monitoring during CPB when compared to baseline (Table 1). Hemodynamics returned to baseline levels at the end of the protocol. Analysis of 34 paired data sets of ScvO2-cath and ScvO2-blood measurements showed a significant correlation (r=0.93, p<0.001) and close linear relationship as determined by regression analysis (y=0.92x+6.73, r2=0.90, p<0.001). Bland-Altman analysis revealed a ±0.03% difference of means (bias) with ±4.11% precision (Figure 2b). ScvO2-cath correlated with cardiac index (r=0.87, p<0.001) showing a polynomial regression (y=20.4+24.5x-1.1x2, r2=0.84, p<0.001). Figure 2c in a total of 119 paired data sets. Correlations of ScvO2-cath with MAP (r=0.59, p<0.001), MPAP (r=0.44, p<0.001), and CVP (r=0.38, p<0.001) were also found. When compared to ScvO2-cath, correlations of hemodynamic parameters to CI were weaker, including matching (r=0.61, p<0.001), MAP (r=0.38, p<0.001), CI (r=0.35, p<0.001) and HR (r=0.25, p<0.001). Demographic data of the 16 pediatric patients can be found in Table 2. Analysis of 99 paired data sets of ScvO2-cath and ScvO2-blood measurements showed a significant correlation (r=0.94, p<0.001) and close linear relationship as determined by regression analysis (y=0.95x+3.59, r2=0.88, p<0.001). Figure 3a). Differences of means (bias) were -0.03% with ±4.14% precision (Figure 3b). Correlations of ScvO2-cath were found with PaO2 (r=0.46, p<0.001) and SpO2 (r=0.35, p<0.001), but not with other hemodynamic parameters. However, in the intraoperative period, continuous ScvO2-cath

CONCLUSION

We have demonstrated the accuracy of a novel oximetric continuous ScvO2 CVC during a wide range of experimentally controlled hemodynamic changes and in pediatric patients undergoing surgery for congenital heart disease. Additionally, ScvO2 accuracy and reliability in anesthetized pigs and was found to be superior when compared to routine hemodynamic parameters. There appears to be lower risk associated with the placement of oximetric CVCs when compared to PA catheterization. Continuous ScvO2 measurement appears feasible for pediatric patients undergoing open cardiac surgery with CPB.

REFERENCES


Continuous Central Venous Saturation Measurement in Pediatric Patients undergoing Cardiac Surgery

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