

Respiratory Variations in SpO₂ with a Fast Pulse Oximeter

Syring R.S., Otto C.M., Campbell V., Baumgardner J.E. *Anesthesiology* 2003; 99: A375.

Introduction

Cyclical recruitment (CR) of atelectasis is thought to contribute to ventilator-associated lung injury (VALI), but in routine clinical practice there is no way to assess CR. One consequence of CR is that arterial PO₂ changes throughout the breathing cycle (1). Recently developed methods for processing pulse oximeter signals (FastSat, Masimo SET Radical) may respond rapidly enough to follow changes in arterial saturation within each breath. We assessed the ability of FastSat to follow respiratory changes in arterial saturation by examining the SpO₂ signal for respiratory oscillations, in an animal model of acute lung injury with known respiratory oscillations in PaO₂.

Methods

Our model of acute lung injury in rabbits has been reported previously (1). After IACUC approval, surfactant deficiency was created in an anesthetized female NZW rabbit by saline lavage, with 3 lavages of 27 ml/Kg per lavage. A rapidly responding fluorescence quenching arterial PO₂ probe (Ocean Optics, Dunedin FL) was placed in the distal aorta. Mechanical ventilation in this model of acute lung injury results in substantial oscillations in PaO₂, a direct measure of CR. The LNOP probe of a Masimo Radical pulse oximeter, with FastSat enabled, was applied to the rabbit forepaw. FiO₂, PEEP, and respiratory rate were adjusted to provide PaO₂ oscillations in a range of PO₂ high enough for tracking by the PO₂ probe, and low enough to cause changes in SaO₂.

Results

Amplitude of respiratory changes in PaO₂ was 22 Torr (figure 1). The FastSat signal also showed respiratory variation in saturation, with peak-to-peak amplitude of 1.9 %. Although the saturation changes were small, the respiratory component of the saturation is clearly distinguishable from background noise. The PaO₂ and SpO₂ signals in figure 1 are not synchronized and contain no information on phase relationships.

Conclusions

Preliminary comparison of respiratory changes in SpO₂ from Masimo Radical, with FastSat enabled, to an established laboratory method suggests that the response time of the pulse oximeter is fast enough to track respiratory changes. Because this new technology is noninvasive and could be applied routinely in mechanically ventilated patients, this new device has potential to provide bedside assessment of cyclical recruitment and adjustment of mechanical ventilation to reduce VALI.

Reference: (1) Baumgardner, et al., *Am J Respir Crit Care Med* 166, 1556-1562.

Figure 1

