**Improved Pulse Oximeter Performance during Motion Artefact Does Not Include Increased Accuracy and Reliability during Cardiac Arrhythmia.**

Lutter N., Mell J., Kozma E., Schuettler J. *Anesthesiology* 2004; 101: A589.

## Introduction

A recent study reported largely erroneous PR readings and, additionally, errors in the saturation estimates (SpO2) with newer models of "motion-resistant" pulse oximeters during cardiac arrhythmia (1). This study aims to determine whether or not improved signal processing algorithms, designed to increase performance during motion artifact, ameliorate the reliability of pulse oximetry in arrhythmic patients.

## Method

After institutional approval and informed consent, 80 ICU patients (ASA II-IV, aged between 28 and 89 yrs) suffering from cardiac arrhythmia (atrial fibrillation, ventricular extrasystoles etc.) were connected simultaneously to a IVY 2000 (Masimo SET V.2), a Masimo Radical (Masimo SET V.3), and a Nellcor N-595 pulse oximeter utilizing randomly placed proprietary finger probes. Alarm limits of the PR were set at 60 and 120 bpm, respectively, those of the SpO2 to ± 3% (maximum lower alarm limit ≤ 95%) of the fractional hemoglobin saturation (SaO2) subsequent to an initial in vitro blood sample analysis (2*Radiometer OSM3). Patients with low cardiac output were precluded from this study as were patients with inadequate signal strength (perfusion index of the Philips Viridia patient monitor < 0.5). SpO2, pulse rate (PR) and heart rate (HR) were recorded continuously and alarm events were classified immediately by a clinically experienced anesthesiologist into technical/physiological and false/correct to calculate sensitivity [TP/(TP+FN)] and specificity [TN/(TN+FP)] (TP = true positive, FP = false positive, TN = true negative, FN = false negative).

## Results

The comparison of SaO2 with SpO2 yielded unacceptable correlation coefficients (IVY: 0.69, N-595: 0.77, Radical: 0.81). Surprisingly, Student's t-testing did not prove a significant difference between the two Masimo SET pulse oximeters indicating that the accuracy of the SpO2 readings was not improved. Out of a total of 1049 alarm events (TP + FP), false positive (FP) alarms, mostly caused by erroneous PR readings, were least frequent with N-595 (n=24), followed by IVY (n=151), and Radical (n=203), i.e. FP events occurred <1/hr with N-595, 5.2/hr with IVY, and 5.3/hr with Radical. In contrast to FP alarms FN events regarding the pulse rate were rare with all devices: n=10 with N-595, n=34 with IVY, and n=27 with Radical. As a consequence sensitivity appeared consistently high (N-595 97 %, IVY 88 %, Radical 81%), whereas specificity was lower with Radical (57 %) when compared to IVY (87 %). During a total measuring time of 67.5 hrs, the time in which data were unavailable for technical reasons (INOP), was short for each device: 0.39 % with N-595, 0.33 with IVY, and 1.04 % with Radical.

## Conclusion

Newer studies found that different approaches improved pulse oximeter performance during patient motion with the Masimo technology performing superior to other developments (2). However, the advancements of Masimo SET V.3 vs. Masimo SET V.2 are not capable of improving pulse oximeter performance if cardiac arrhythmia is present. More importantly, the low agreement of SpO2 with SaO2 evidently indicate a persistently decreased accuracy of SpO2 indications during cardiac arrhythmia.

Reference: 1. Anesthesiology 2004, 99:A624. 2. Anesth Analg.2002; 95:967-72.