21 Is There a Difference in Recovery Time for the Accurate Display of Oxygen Saturation (SpO_2) and Pulse Rate (PR) after Motion Induced Failure of Pulse Oximeters (PO) during Low Perfusion and Normoxemia or Hypoxemia in Human Volunteers?

Shah N, Clack SL, Hoang TD. *Anesthesiology* 2001; 95:A-552 (www.asa-abstracts.com)

Introduction

Monitoring arterial oxygen saturation with pulse oximetry has become standard of care in the Operating Room (OR) and Post Anesthesia Care Unit (PACU). Patient movement occurs frequently in the PACU and in the OR, especially during pediatric induction and emergence. Conventional pulse oximeters do not perform well in motion especially when there is low perfusion at the monitored site. The length of time it takes a pulse oximeter to recover and display accurate values for both SpO_2 and pulse rate after failure may be of critical importance in many clinical situations. These researchers wanted to compare differences in motion and low perfusion induced failure rate and the time to redisplay accurate numbers (recovery time) among "motion resistant" pulse oximeters.

Methods

Seven healthy adult subjects (5 females and 2 males) between 18 and 40 years of age were studied. The subjects were instrumented with 3 test pulse oximeters on the left hand and 3 control pulse oximeters were connected to fingers on the right hand. The testing protocol was performed twice with each subject with 2 difference groups of "motion resistant" pulse oximeters. In one study group the Masimo Radical V3 (Masimo I) was compared with HP Agilent Viridia 24C Rev C.0, and Novametrix MARS v2001-10. In the other study group, the Masimo Radical V3 (Masimo II) was compared with the Nellcor N-395 v1620, and HP CMS Rev B.0. The room temperature was held at 16° to 18° C to reduce peripheral perfusion. The sensors were randomly placed on the index, middle, and ring fingers of the test hand. The test hand was fixed to a motion generator capable of producing tapping and rubbing motions. The motions studied during normoxemia (room air breathing) were tapping at 3 Hz, tapping at 3Hz with a disconnect and reconnect of the sensors during motion, and a random rubbing motion. Hypoxemia was induced via a disposable rebreathing circuit. 100% oxygen was given once SpO_2 reached ≈ 75% to facilitate quick resaturation. The motions studied during the hypoxic challenge were: random tapping and 3Hz tapping with disconnect and reconnect of sensors during both motions, random rubbing and 3Hz rubbing. During the normoxemic testing, the sensors were rotated such that each test oximeter was studied on each of the three test digits. Recovery time (RT) was defined as the time required for the pulse oximeter to redisplay the SpO_2 control value or pulse rate after cessation of motion. Failure Rate (FR) was defined as the % of time the pulse oximeter displayed a value which was off by 7% of the control SpO_2 or off by 10% of the control value for pulse rate.

Results

Pulse Oximeter	SpO_2		Pulse Rate	
	Mean Recovery Time in seconds (range)	Failure Rate	Mean Recovery TIme in seconds (range)	Failure Rate
Masimo SET I	21.3 (10-50)	13%	14.4 (3-35)	26%
Novametrix MARS	22.2 (5-55)	74%	23.1 (4-63)	80%
Philips/HP Viridia 24C Rev C.0	31.1 (10-85)	46%	45.5 (10-192)	71%
Masimo SET II	17.8 (10-40)	11%	13.6 (1-39)	30%
Philips/HP CMS Rev C.0	40.5 (11-97)	23%	37.8 (5-103)	38%
Nellcor N-395	19.9 (10-141)	40%	38.2 (7-155)	55%

Authors' Discussion and Conclusion

The authors concluded that among the "motion resistant" pulse oximeters tested, the Masimo SET pulse oximeter may perform the best during patient monitoring due to its low failure rate and short recovery time.