An Intraoperative Comparison of Ear Transmission and Forehead Reflectance Oximetry in Pediatric Surgical Patients.

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Introduction:

Pulse oximetry is a standard of care in the operating room and the ICU. Recent studies have demonstrated potential differences in response time for detection of adverse events between finger sensors and sensors located on the head1. This study evaluates the accuracy and reliability of the new Nellcor Max-Fast forehead sensor, used with the Nellcor N595 oximeter, compared to the Masimo new ear sensor, the Tip Clip (TC-I), used with a Masimo SET Radical oximeter, in stable intraoperative pediatric surgical patients.

Methods

Following IRB approval, 24 pediatric patients undergoing general anesthesia were enrolled prospectively. Sensors from 4 pulse oximeters were attached to patients. The Nellcor Max-Fast forehead sensor and the Max-P or Max-I sensor were connected to Nellcor N595 oximeters. The Masimo LNOP Pdt or Inf-L sensor and the Masimo TC-I ear sensor were connected to Masimo SET Radicals. The 2 digit sensors were optically shielded from one another. SpO2 and pulse rate values from these oximeters were continuously logged on computer throughout surgery. The mean of the two digit sensors was calculated, as were the bias and precision. “Error” is defined as the difference between the forehead sensor or the ear sensor and the mean of the 2 digit sensors during stable conditions. The bias (mean error) and precision (SD of the error) as well as the E7 (% of time during which the error was greater than 7% in stable conditions) were calculated for the forehead sensor and the TC-I as well. In this study, failure of a sensor is defined as an E7% > 20% of the duration of the case. Paired t-tests were used to compare values with significance determined by $p<0.05$.

Results

The mean age of the patients was 9.3 (±4.5) years. The mean length of surgery (minutes) was 53.5 (±25.2). Pooled data results from 24 patients are shown in Table 1. The failure rate for the Nellcor Max-Fast was 33%, while that of the Masimo TC-I was 0%.

Data Mean (± SD) for the sensors

	pooled digit data	Nellcor Max Fast	Masimo TC-I	p value (between Max Fast and TC-I)
Bias (%)	-0.2±0.9	-4.1±6.0	0.3±0.7	0.005
Precision (%)	0.3±0.3	2.7±3.4	0.5±0.5	0.006
E7 (%)		20.2±30.7	0.6±1.5	0.004
Performance Index		79.8%	99.4%	

Discussion

Twelve years ago, studies reported that reflectance oximetry sensors performed poorly2. Despite advancements in technology, this study demonstrated similar poor performance of the forehead reflectance pulse oximeter. The Max-Fast sensor attached to the N595 oximeter demonstrated an unacceptable bias and precision and failed in 33% of the patients. In contrast, the TC-I sensor never failed and performed well as indicated by a small bias and precision.

1) Anesthesiology 1990;73(3A):A544; 2) J Clin Monit 1991; 7:102-103