A Clinical Comparison of Pulse Oximeter Sensor Sites in the Pediatric Surgical Patient: Ear, Nose, Lip and Forehead.

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Introduction

There are adverse conditions, which can impair the performance of digit sensors such as low perfusion1 and motion2. These problems can be avoided by sensors placed on the head. Sensors located on the head have a faster response time (up to one minute) than do digit sensors3. The object of this study was to evaluate sensors placed on various locations on the head.

Methods

Following IRB approval, 24 pediatric surgical patients undergoing general anesthesia were prospectively enrolled. Five pulse oximeters and sensors were attached to the patients as follows. The Nellcor Max-P or Max-I sensor attached to a Nellcor N595 oximeter (n=24). The Masimo LNOP Pdt or Inf-L sensor (n=24), Masimo TC-I ear sensor (n=24), Masimo TF-I forehead sensor (n=24), Masimo TC-I attached to the nose (n=18) or the lip (n=6) were connected to Masimo SET Radical oximeters. The 2 digit sensors were optically shielded from one another. SpO2 and pulse rates from these five 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 each of the head sensors and the mean of the 2 digit sensors during stable patient 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 all sensors. Failure in this study was 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 (±25.3). Results of pooled data for 2 patients are shown in Table 1. In none of the 24 patients was there a clinical failure of the sensors. DISCUSSION: Since head sensors have a faster response time than digit sensors to changing SpO2, these alternative sites are valuable tools for monitoring the pediatric surgical patient. Masimo’s TC-I and TF-I sensors on all sites demonstrated a 0% failure rate and a high degree of reliability. Our data demonstrates the usefulness of these alternative sites in monitoring SpO2 in pediatric surgical patients, whose traditional pulse oximetry sites may be difficult and unreliable to monitor.

Data Mean (±SD) for the Masimo TC-I and TF-I sensors placed on various parts of the head

	pooled digit data	Ear (TC-I)	Naris (TC-I)	Lip (TC-I)	Forehead (TC-I)
Bias (%)	-0.2±0.9	-0.3±0.7	-0.1±0.6	-0.6±0.6	0.1±0.5
Precision (%)	0.3±0.3	0.5±0.5	0.4±0.3	0.6±0.4	0.5±0.6
E7 (%)		0.6±1.5	0.3±1.4	0.8±2.0	0.6±1.7
Performance Index		99.4%	99.7%	99.2%	99.4%

1. Anesthesiology 1990; 73: 532-537.; 2. Anesth. Analg. 2002; 95: 967-972.3. Anesthesiology 1990; 73(3A): A544.