

AARC Clinical Practice Guideline

Pulse Oximetry

PO 1.0 PROCEDURE:

Pulse Oximetry (SpO₂)

PO 2.0 DESCRIPTION/DEFINITION:

Pulse oximetry provides estimates of arterial oxyhemoglobin saturation (SaO₂) by utilizing selected wavelengths of light to noninvasively determine the saturation of oxyhemoglobin (SpO₂). (1-6)

PO 3.0 SETTING:

Pulse oximetry may be performed by trained personnel in a variety of settings including (but not limited to) hospitals, clinics, and the home. (7,8)

PO 4.0 INDICATIONS:

4.1 The need to monitor the adequacy of arterial oxyhemoglobin saturation (1,4,6,9)

4.2 The need to quantitate the response of arterial oxyhemoglobin saturation to therapeutic intervention (4,9,10) or to a diagnostic procedure (eg, bronchoscopy)

4.3 The need to comply with mandated regulations (11,12) or recommendations by authoritative groups (13,14)

PO 5.0 CONTRAINDICATIONS:

The presence of an ongoing need for measurement of pH, PaCO₂, total hemoglobin, and abnormal hemoglobins may be a relative contraindication to pulse oximetry.

PO 6.0 HAZARDS/COMPLICATIONS:

Pulse oximetry is considered a safe procedure, but because of device limitations, false-negative results for hypoxemia (4) and/or false-positive results for normoxemia (15,16) or hyperoxemia (17,18) may lead to inappropriate treatment of the patient. In addition, tissue injury may occur at the measuring site as a result of probe misuse (eg, pressure sores from prolonged application or electrical shock and burns from the substitution of incompatible probes between

instruments).(19)

PO 7.0 DEVICE LIMITATIONS/VALIDATION OF RESULTS:

7.1 Factors, agents, or situations that may affect readings, limit precision, or limit the performance or application of a pulse oximeter include

7.1.1 motion artifact(2,5,8,9,20)

7.1.2 abnormal hemoglobins (primarily carboxyhemoglobin [COHb] and met-hemoglobin [metHb])(1,3,5,8,9,21)

7.1.3 intravascular dyes(1,3,8,9)

7.1.4 exposure of measuring probe to ambient light during measurement(2,3,8,9)

7.1.5 low perfusion states(1,3,4,8,9,21)

7.1.6 skin pigmentation(5,9,10,21)

7.1.7 nail polish or nail coverings with finger probe(9)

7.1.8 inability to detect saturations below 83%(22) with the same degree of accuracy and precision seen at higher saturations(9,10,21,23,24)

7.1.9 inability to quantitate the degree of hyperoxemia present(17)

7.1.10 Hyperbilirubinemia has been shown *not* to affect the accuracy of SpO₂ readings.(25,26)

7.2 To validate pulse oximeter readings, incorporate or assess agreement between SpO₂ and arterial oxyhemoglobin saturation (SaO₂) obtained by direct measurement(1,4,5,21)--these measurements should be initially performed simultaneously(4,21) and then periodically re-evaluated in relation to the patient's clinical state.(6,27,28)

7.3 To help assure consistency of care (between institutions and within the same institution) based on SpO₂ readings, assess

7.3.1 selection of proper probe and appropriate placement (the probe is at-tached to its intended site);

7.3.2 for continuous, prolonged monitoring, the Hi/Low alarms are appropriately set;

7.3.3 specific manufacturer's recom-mendations are complied with, the device is applied and adjusted correctly to monitor response time(5,29) and electrocardio-graphic coupling;(20)

7.3.4 strength of plethysmograph waveform or pulse amplitude strength; assure that device is detecting an adequate pulse.

7.4 SpO₂ results should be documented in the patient's medical record and should detail the conditions under which the readings were obtained:

7.4.1 date, time of measurement, and pulse oximeter reading; patient's position, activity level, and location;(4) during monitoring, assure that patient's activity is according to physician's order;

7.4.2 inspired oxygen concentration or supplemental oxygen flow, specifying the type of oxygen delivery device;

7.4.3 probe placement site(4) and probe type;

7.4.4 model of device (if more than one device is available for use);

7.4.5 results of simultaneously obtained arterial pH, PaO₂, and PaCO₂, and directly measured saturations of COHb, MetHb, and O₂Hb₄ (if direct measurement was not simultaneously performed, an additional, one time statement must be made explaining that the SpO₂ reading has not been validated by comparison to directly measured values);

7.4.6 stability of readings (length of observation time and range of fluctuation, for continuous or prolonged studies, review of recording may be necessary);

7.4.7 clinical appearance of patient--subjective assessment of perfusion at measuring site (eg, cyanosis, skin temperature); (9)

7.4.8 agreement between patient's heart rate as determined by pulse oximeter and by palpation and oscilloscope.(2,17,28,30)

7.5 When disparity exists between SpO₂, SaO₂ readings, and the clinical presentation of the patient, possible causes should be explored before results are reported. Discrepancies may be reduced by monitoring at alternate sites or appropriate substitution of instruments or probes.*If such steps do not remedy the disparity, results of pulse oximetry should not be reported*; instead, a statement describing the corrective action should be included in the patient's medical record, and direct measurement of arterial blood gas values should be requested. The absolute limits that constitute unacceptable disparity vary with patient condition and specific device. Clinical judgment must be exercised.

PO 8.0 ASSESSMENT OF NEED:

8.1 When direct measurement of SaO₂ is not available or accessible in a timely fashion, a SpO₂ measurement may temporarily suffice if the limitations of the data are appreciated.(9,10)

8.2 SpO₂ is appropriate for continuous and prolonged monitoring (eg, during sleep, exercise, bronchoscopy).(1,6,7,9,10,14,31)

8.3 SpO₂ may be adequate when assessment of acid-base status and/or PaO₂ is not required.(1,4,9,10)

PO 9.0 ASSESSMENT OF OUTCOME:

The following should be utilized to evaluate the benefit of pulse oximetry:

9.1 SpO₂ results should reflect the patient's clinical condition (ie, validate the basis for ordering the test).

9.2 Documentation of results, therapeutic intervention (or lack of), and/or clinical decisions based on the SpO₂ measurement should be

noted in the medical record.

PO 10.0 RESOURCES:

10.1 Equipment: pulse oximeter and related accessories (probe of appropriate size)--the oximeter should have been validated by the manufacturer by a comparison of its values (and consequently its calibration curve) with directly measured oxyhemoglobin saturation.(17,32)

10.2 Personnel: Pulse oximetry is a relatively easy procedure to perform. However, if the procedure is not properly performed or if it is performed by persons who are not cognizant of device limitations or applications, spurious results can lead to inappropriate intervention.

10.2.1 Level I--personnel trained in the technical operation of pulse oximeters, oxygen delivery devices and related equipment, measurement of vital signs, and record keeping--may perform and record results of pulse oximetry but should be supervised by Level II personnel.

10.2.2 Level II--health care professionals trained in patient assessment, disorders of acid-base, oxygenation and ventilation, and diagnostic and therapeutic alternatives--evaluate patients and recommend and/or make changes in therapy based on assessment.

PO 11.0 MONITORING:

The clinician is referred to *Section 7.0 Validation of Results*. The monitoring schedule of patient and equipment during continuous oximetry should be tied to bedside assessment and vital signs determinations.

PO 12.0 FREQUENCY:

After agreement has been initially established between SaO₂ and SpO₂, the frequency of SpO₂ monitoring (ie, continuous vs 'spot check') depends on the clinical status of the patient, the indications for performing the procedure and recommended guidelines.(14,31) For example, continuous SpO₂ monitoring may be indicated throughout a bronchoscopy for detecting episodes of desaturation,(3,31) whereas a spot check may suffice for evaluating the efficacy of continued oxygen therapy in a stable postoperative patient. However, it must be emphasized that direct measurement of SaO₂ is necessary whenever the SpO₂ does not confirm or verify suspicions concerning the patient's clinical state.

PO 13.0 INFECTION CONTROL:

No special precautions are necessary, but Universal Precautions (as described by the Centers for Disease Control(33,34)) are

recommended.

13.1 If the device probe is intended for multiple patient use, the probe should be cleaned between patient applications according to manufacturer recommendations.

13.2 The external portion of the monitor should be cleaned according to manufacturer's recommendations whenever the device remains in a patient's room for prolonged periods, when soiled, or when it has come in contact with potentially transmissible organisms.

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