Pulse oximetry

Pulse oximetry **non-invasively measures the oxygen saturation of hemoglobin** in the arterial part of the bloodstream (pulsatile flow).

See Pulse oximetry principles for more info

The location of the detector is the **fingers of the limbs or the earlobes**. Due to the circulation time, a sensor placed on the earlobe detects changes earlier than a sensor placed on the toe. Leaving the transducer in one place for long periods of time runs the risk of tissue damage from pressure. In newborns, **physiologically lower values** are due to the presence of R-L shunts.

Interpretation of SaO2 values during oxygen therapy

SaO2 values	Clinical notes
Newborns after 10 minutes > 90 % infants over 1 month > 95 %	physiological values
< 92 %	indications for oxygen administration in healthy lungs
< 80 %	critical condition within tens of minutes
< 60 %	immediate critical desaturation

Pulse oximeter

Immediately after birth, satisfactory saturation in the first min is from 60% upwards, in the fifth minute over 85%, in up to the tenth minute of life we expect 90% or more

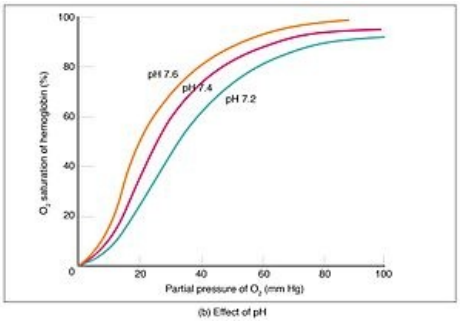
Relationship between SaO_2 and pO_2

The relationship between PO2 and SaO2 is given by the **hemoglobin dissociation curve**. Due to its **axis-shaped course**, SaO2 monitoring does not allow detection of changes in PaO2 in the low and high range of values (SaO2 values < 70% and SaO2 values > 98%). Factors that affect the position of the hemoglobin dissociation curve also affect the SaO2 value. These changes are significant only on the s**teep part of the dissociation curve**.

In patients with normal pH and body temperature values, a SaO2 value of 90% corresponds to a pO2 of about 60-65 mm Hg (= 8-8.6 kPa). In clinically detectable cyanosis in patients without anaemia, SaO2 parameters are usually already around 80%. Pulse oximetry does not correlate well with excessively high pO2, e.g. at a SaO2 of 98% the pO2 may be 10 or even 20 kPa and this is already toxic hyperoxia. This fact is particularly important in neonatology.

Overview of the most common causes of artefacts in pulse oximetry

- Low perfusion of the measurement site → hypotension, low cardiac output, hypothermia;
- severe anemia;
- Excessive ambient light intensity;
- Incorrect sensor position;
- sensor movement;
- venous pulsation in the lower limb;
- high skin pigment content (blacks, tans, ...).



Dissociation curve of hemoglobin

The most common cause of artifact is the loss of pulsatile signal character during hypoperfusion of the monitored site.

Clinical notes on SaO_2 assessment

Carbon monoxide intoxication produces carboxyhaemoglobin (COHb), which has virtually the same ability to absorb light at 660 nm wavelength as oxyhaemoglobin, which is why standard oximeters give a falsely high SaO2 value in the presence of COHb.

In **methaemoglobinaemia**, we detect a SaO2 value of 85% because methaemoglobin has the same absorption coefficient for red and infrared light. Thus, methaemoglobinaemia leads to a falsely low SaO2 value if its true value is greater than 85% and to a falsely high value if its true value is less than 85%.

In **anaemia**, we detect a high SaO2 value relative to oxaemia, since erythrocytes are well saturated at low concentrations. Conversely, we detect falsely low SaO2 values in polyglobulinemia.

In **hypoperfusion**, SaO2 may be falsely low or high (→ if the pulse oximeter senses currently open AV shunts).

In **icterus** and **presence of dyes** in the body (methylene blue), we detect falsely low values, as well as when using nail polish.

Arrhythmias will cause irregularities in the waveform and therefore changes in the average measured saturation, a severe tricuspid defect by the mechanism of transmitted venous pulsation can cause errors in signal measurement.

References

Related articles

- Cardiopulmonary monitoring
- Principles of pulse oximetry

Source

ŠEVČÍK, Pavel, et al. *Intenzivní medicína.* 3. edition. Galén, 2014. 1195 pp. pp. 179–183. ISBN 978-80-7492-066-0.

- HAVRÁNEK, Jiří: *Cardiopulmonary monitoring*.