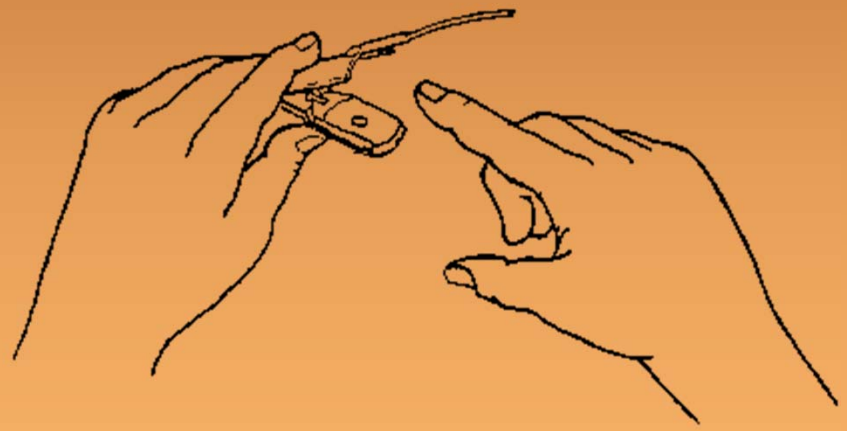
ADVANCED ASSESSMENT
Principles Of Oximetry



ADVANCED ASSESSMENT
Principles Of Oximetry

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How it works

- A pulse oximeter (SpO_2 monitor) is a non-invasive device which measures the percentage of hemoglobin saturated with oxygen.
- It emits red and infrared light through vascular tissue and measures the amount of absorbed light on the other side.
- Hemoglobin changes its shape depending on whether or not it's carrying oxygen molecules.
- Light absorption also changes depending on whether the hemoglobin is carrying oxygen.
- This is how a percentage of oxygen "saturation" is derived.

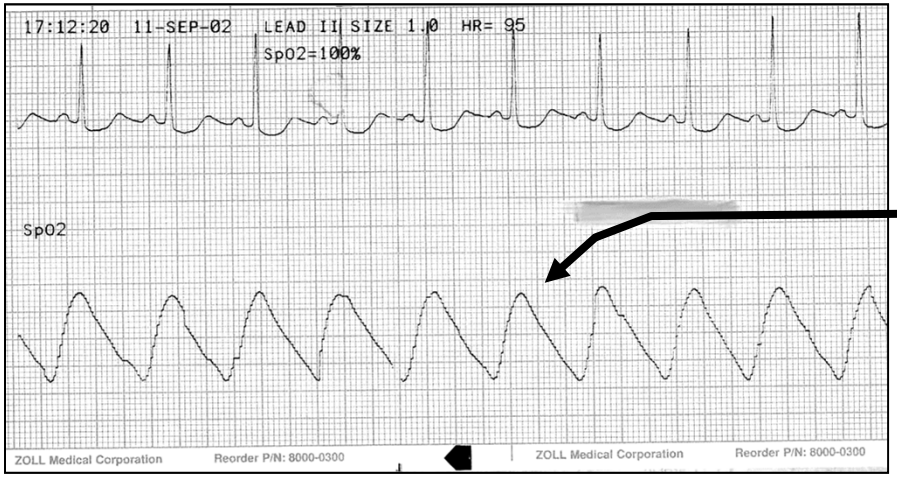
How it works

- 98% of oxygen is transported bound to hemoglobin – the rest is transported dissolved in blood plasma
- hemoglobin is part of the red blood cell
- each hemoglobin can carry 4 molecules of O_2 (said to be fully saturated)
- normal saturation is 95-98% (or as high as 100%) on room air
- a saturation of 94% = hypoxemia (strict definition of hypoxemia is: PaO_2 less than 80 mmHg)

How it works

- tissue displacement is also incorporated into the SpO_2 calculation for accuracy.
- Tissue displacement is represented on the SpO_2 monitor in the form of a plethysmograph - sometimes called the “pleth” for short or a “pulse waveform”.
- Note: SpO_2 monitors are sometimes sensitive to motion artifact. If you look at the plethysmograph and the waveform morphology (shape) is the same with each pulse, then the numeric value (% saturation) will be accurate.

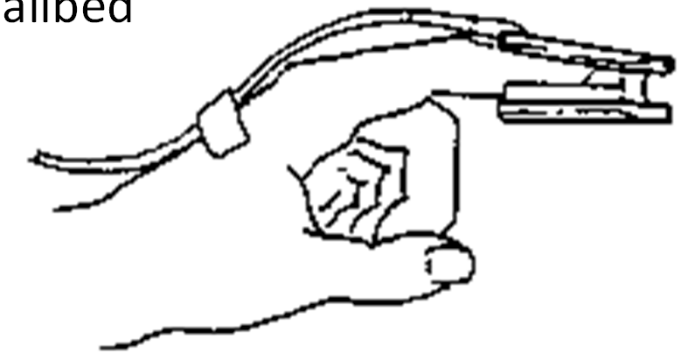
plethysmograph



Note that the shape of the "Pleth" is consistent and that each wave corresponds to an ECG wave above. This tells you that the numeric value is accurate

How it works - adult

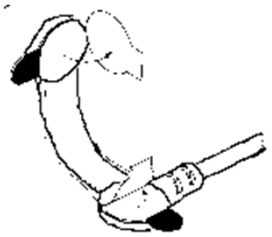
- In an adult, you generally apply the SpO_2 probe to the finger (see below).
- Be sure that the light source is directly over the sensor - i.e. be careful no to push the probe on too far. The light source should be directly over the nailbed



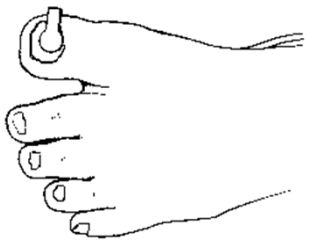
Finger probe

How it works - pediatric

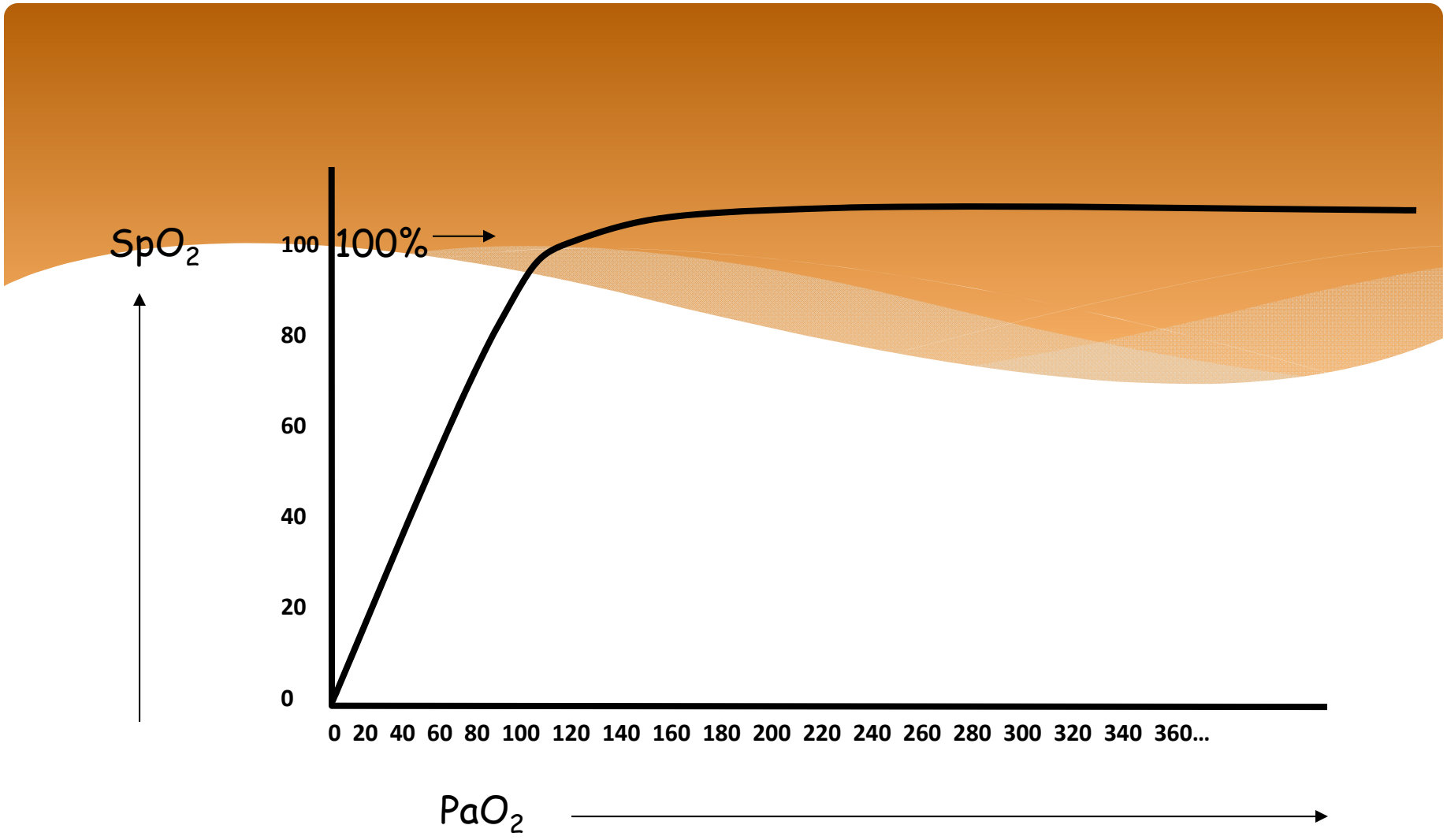
- In an infant you might choose a disposable probe to place around the big toe.



Disposable probe



Wrap and secure toe so that the light source is directly over the sensor

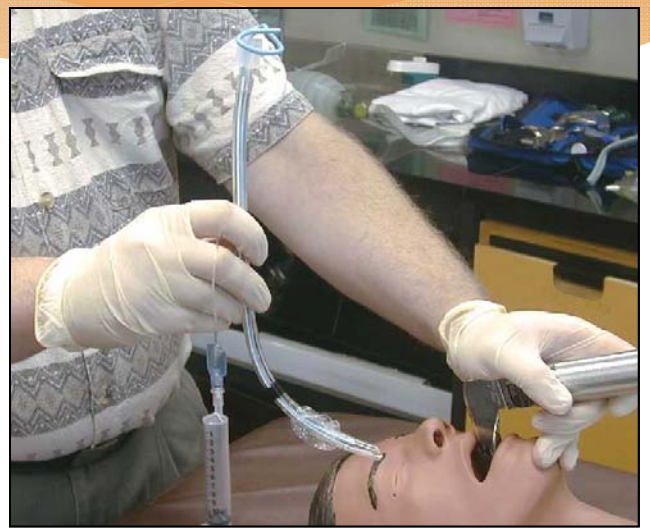

SpO2
100
100%
80
60
40
20
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360…
PaO2

Indications for SpO_2 monitoring

- any patient who requires supplemental O_2
- any patient receiving analgesia and/or sedation
- as an adjunct assessment tool for anyone requiring positive pressure ventilation (PPV) by mask or by ETT
- to assist in ruling out the need for O_2 therapy
- any patient to be transported by air

Benefits of SpO_2 monitoring (cautious)

- continuous monitoring of oxygenation status
- to monitor the efficacy of therapeutic interventions. e.g. O_2 therapy, treatment with Salbutamol, NTG for A.P.E., etc
- guide for efficacy of ventilation-oxygenation of the patient who is receiving PPV
- guide for oxygenation needs in the patient who is being intubated



Clinical points

- Whenever possible, the Paramedic should attempt to obtain an SpO_2 reading on room air, followed by a reading with supplemental oxygen

- Important: NEVER withhold oxygen from the patient in severe respiratory distress

A drop in SpO_2 may occur before the development of cyanosis in a patient whose respiratory status is deteriorating – therefore SpO_2 may provide an early warning sign

Limitations of of SpO_2 monitoring

- Anemia - the anemic patient may be 100% saturated, but his/her oxygen carrying capacity will be low due to decreased circulating red blood cells (hemoglobin)
- O_2 therapy may be indicated to fully saturate the existing hemoglobin and add to the amount of dissolved O_2 in the blood plasma

e.g. various types of anemia's - pregnancy

e.g. hypovolemia

Limitations of SpO_2 monitoring

EXAMPLES

- carboxyhemoglobin - the patient who has CO poisoning may have a high SpO_2 reading, however this is because the pulse oximeter cannot distinguish between CO bound to hemoglobin from O_2 bound to hemoglobin
- hypoperfusion - inadequate pulsations
- arterial compression or disruption- i.e. from injury or from application of a blood pressure cuff on the same arm that is used to get the SpO_2 reading
- ambient light
- nail polish

Limitations of SpO_2 monitoring

EXAMPLES

- motion artifact
- patients with chronically impaired oxygenation (e.g. emphysemics) will normally saturate low. - if an emphysemic is saturating at 91% but is otherwise in no distress whatsoever, then 91% should not be taken as seriously as one would take a saturation of 91% in a patient with normally healthy lungs.

SpO_2 summary

- monitors oxygenation
- guide to the efficacy of interventions
- early warning device
- has its limitations

Well Done!

Ontario Base Hospital Group

Self-directed Education Program