ACCU KIT OF THE WEEK

THE ROYAL LONDON HOSPITAL

Pulse Oximeter

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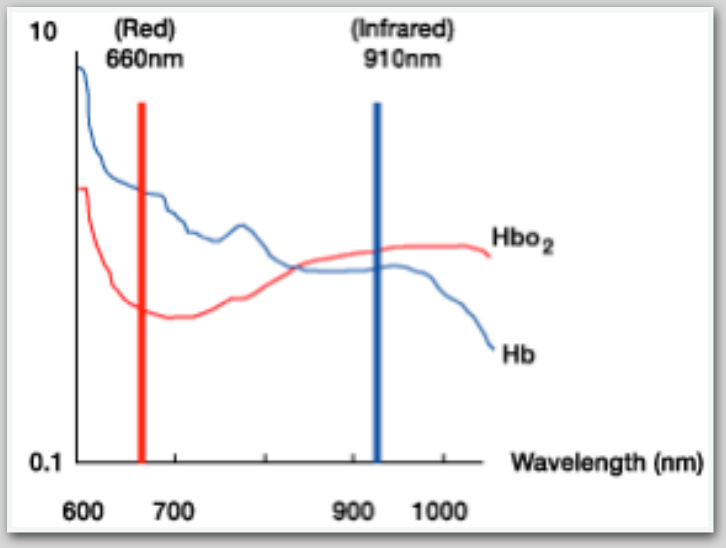
What's it for?

Pulse oximetry provides continuous non-invasive monitoring of the haemoglobin oxygen saturation in arterial blood.

How does it work?

The underlying physical principle is that infrared light is absorbed to different degrees by the oxygenated and deoxygenated forms of haemoglobin. The pulse oximeter uses two light emitting diodes which emit pulses of red (660nm) and infra-red (980nm) light every 5-10ms.

At a wavelength of 660nm oxygenated haemoglobin absorbs less than deoxygenated. At a wavelength of 940nm deoxygenated haemoglobin absorbs more than oxygenated.



At 800nm (the isobestic point) the absorption coefficients are identical. The opposite side of the probe has a photocell that detects the amplitude of the red and infrared lights. The ratios of these amplitudes allows the microprocessor to give an estimate of the SpO2 by comparing the values with those from tables stored in its memory produced from experimental data.

The oximeter detects the points of maximum and minimum absorption (during cardiac systole and diastole). It measures the pulsatile component and subtracts the non-arterial constant component before displaying a pulse waveform and the percentage saturation.

Limitations?

Calibrated against volunteers and so calibration against dangerously hypoxic values is impossible. Therefore accuracy is compromised at SpO2 values <70%. Assumes that only the pulsatile absorbance is arterial blood. Lag time, often about 30 seconds. Intervention may be required before desaturation is detected. In very anaemic patients saturations may read high although oxygen delivery to the tissues may be impaired. Only provides information on oxygenation not ventilation.

Sources of Error?

Interference of ambient light, although the pulsed nature of the emissions is intended to allow detection of, and compensation for, any ambient light. Infra-red absorption by other substances such as nail varnish or nicotine. Conditions that cause loss of the pulsatile component, such as hypoperfusion, hypothermia, peripheral vasoconstriction and arrhythmias. Movement artefact. Electrical interference.

Causes of high co-oximetry and low pulse oximetry readings:

Dyes such as methylene blue or disulphine blue, Severely jaundice patients, as bilirubin has a similar absorption coefficient to haemoglobin, Methaemoglobinaemia (absorption similar at both wavelengths so gives a reading of 84%)

Causes of low co-oximetry and high pulse oximetry readings:

Carboxyhaemoglobin (absorption similar to oxygenated haemoglobin and therefore will give an abnormally high reading, usually about 96%). Radiofrequency interference from MRI.

A growing body of evidence suggests that the non-ethnically diverse calibration population renders oximetry less reliable for darker skinned patients (potentially dangerously over-reading low sats).