Pulse oximetry

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Bedside non-invasive pulse oximetry is used frequently by many nurses in a wide variety of clinical areas to complement patient assessment. It is a non-invasive measurement of arterial oxygen saturation.

Pulse oximetry uses two light sources and a detector to measure colour differences between oxygenated and deoxygenated haemoglobin, displaying the former as a percentage.

**Related physiology**

Under normal conditions approximately 99 per cent of oxygen is carried in the blood bound to haemoglobin (Hinchcliffe et al, 1996). The affinity of haemoglobin for oxygen depends on various factors including:

- Blood pH;
- Temperature;
- Carbon dioxide levels.

This relationship is demonstrated in the oxyhaemoglobin dissociation curve (Fig 1). Other substances can also bind with haemoglobin and may bind preferentially over oxygen. Such substances include carbon monoxide and some drug metabolites.

**Clinical application**

Pulse oximetry only measures haemoglobin oxygen saturation. It does not provide information on haemoglobin concentration, oxygen delivery to the tissues or ventilatory function. Thus a patient may present with normal oxygen saturations yet still be hypoxic. There are therefore limitations to this procedure as it only provides limited information about a patient’s condition. However, in conjunction with comprehensive patient assessment it can be a useful tool.

**Indications**

- To monitor the effectiveness of oxygen/respiratory therapy.
- During and after procedures that may require sedation/anaesthesia or carry any kind of risk of respiratory depression.
- For patients with haemodynamic instability.
- As part of general respiratory management in patients with long-term pulmonary disease.
- During the transport of patients who are unwell and require oxygenation assessment.
- During the administration of drugs that may cause respiratory depression, such as patient-controlled analgesia (Dougherty and Lister, 2004).
Limitations
- Sources of error with pulse oximetry are generally related to light transmission or pulse detection.
- High levels of artificial light and the presence of dirt/nail varnish on the probe site may influence light detection (Allen, 2004).
- Most monitors need five pulse beats to calculate SP02, therefore the reading reflects the status 5–10 seconds ago.
- Problems with pulse detection occur where peripheral circulation may be poor – for example, in cases of circulatory shock or peripheral vascular disease – or where there is patient movement such as shivering.
- Accuracy at SP02 levels greater than 80 per cent is highest.
- Light absorption is measured over a number of pulse beats so accuracy is reduced in cardiac arrhythmias.

Choice of probe site
Generally the fingers and toes are used although earlobes and the bridge of the nose have clinical uses. Specifically designed probes may facilitate better measurement with some of these and other areas. The site with the best pulsatile vascular flow should be used in the first instance.

The procedure
- Obtain informed consent for the procedure.
- Allay any anxieties and provide reassurance.
- Ensure good infection control practice, including handwashing and having a clean apron (Fig 2).
- Make sure any equipment used is clean and intact.
- Select the probe site, assessing any barriers, such as nail varnish, that may have any sort of influence on the readings (Fig 3).
- Place probe on patient (Fig 4).
- Assess pulse detection by comparing signal frequency with pulse rate (Fig 5).
- Record oxygen saturation with the other data that has been collected (respiratory rate, depth etc). Also record the flow/concentration of any concurrent oxygen therapy (Fig 6).
- If the monitoring is continuous, assess probe site regularly to identify any soreness/bruising, rotating sites as necessary.
- Set any alarms/parameters to identify a change in recorded saturation levels.

Professional responsibilities
All nurses who measure oxygen saturations must have received approved training and undertaken supervised practice. The onus is also on the individual to ensure knowledge and skills are maintained from both a theoretical and practical perspective.

Nurses should also undertake this role in accordance with their organisation’s own protocols, policies and local guidelines.