A Technical Review On The Existing Pulse Oximeters For The Global Market

Bhargav[1], Basawaraj[1], Vidya MJ[1],
[1]Department of Instrumentation Technology,R.V.College Of Engineering,
Bangalore-560059

***Abstract*—Pulse oximetry is the best method to determine the oxygen saturation in various parts of the patient. Oximeter is used as a safe, non-invasive monitor of the cardio-respiratory status of high-dependency patients-in the emergency department, during general and regional anesthesia, postoperatively and in intensive care. Monitoring includes procedures such as endoscopy, where often frail patients are given sedative drugs such as midazolam. Pulse oximeters detect the presence of cyanosis more reliably than even the best doctors when using their clinical judgment. So it is important to know the best oximeter available in the market in the context of efficiency and economy. This paper has the comparative study of oximeters available in the global market and helps in choosing the best one**.

***Index Terms*— Reflectance oximetry, Oxygen Saturation, SpO2 , cyanosis, midazolam**

I. INTRODUCTION

PULSE OXIMETERS provide an easy way of partly a assessing someone's breathing by measuring the oxygen saturation of arterial blood. The colour of blood varies depending on how much oxygen it contains. A pulse oximeter shines two beams of light through a finger (or earlobe etc.), one beam is red light (visible when a pulse oximeter is used), one is infrared light (invisible).These two beams of light can let the pulse oximeter detect what colour the arterial blood is and it can then work out the oxygen saturation. However there are lots of other bits of a finger which will absorb light (such as *venous* blood, bone, skin, muscle etc.), so to work out the colour of the arterial blood a pulse oximeter looks for the slight change in the overall colour caused by a beat of the heart pushing arterial blood into the finger. This change in colour is very small so pulse oximeters work best when there is a good strong pulse in the finger (etc.) the probe is on. If the signal is too low the measured oxygen saturation may not be reliable and lower than this the pulse oximeter will not be able to work.

II. TYPES OF OXIMETERS[1]

There are the four different types of classifications of the oximeters on the basis of applications, size and complexion.

Figure1.Fingertip oximeter

Figure1 shows the finger tip oximeter which is Most common type used at home and outside of the clinic. They provide oximetry and pulse reading on the top of the area that clips onto the finger. Usually can run on AAA or AA batteries and can be transported easily because they are very light.

Figure 2.Handheld oximeter

Handheld oximeter shown in figure 2 usually which is more sophisticated than a fingertip oximeter and are most commonly recommended for use at a clinic.

They feature a fingertip sensor that is attached to a handheld display device. Care providers can monitor results, store and replay information, and use continuously as opposed to taking intermittent spot checks.

Figure 3. Wrist pulse oximeter

Figure 3 shows wrist type which also provides reliable reading for individual users, but use a display that attaches like a watch to a user's wrist. They can make readouts and regular usage much easier for patients who do not wish to constantly carry around a fingertip oximeter.

Figure 4. Tabletop oximeter

[4]Tabletop: Used frequently in labs and hospitals to monitor patients and conduct sleep studies. These also utilize fingertip probes that are attached to a hardware device which provides useful information to medical professionals. These are much bigger than other pulse oximeters.

III. MANUFACTURERS OF OXIMETERS

- ***SPO MEDICAL***

- ***BCI***

- ***NONIN***

IV. PRACTICAL TIPS TO SUCCESSFUL USE OF PULSE OXIMETRY [3]

[1]Plug the pulse oximeter in to an electrical socket, if available, to recharge the batteries.

[2]Turn the pulse oximeter on and wait for it to go through its calibration and check tests.

[3]Select the probe you require with particular attention to correct sizing and where it is going to go. The digit should be clean (remove nail varnish).

[4]Position the probe on the chosen digit, avoiding excess force.

[5]Allow several seconds for the pulse oximeter to detect the pulse and calculate the oxygen saturation.

[6]Look for a displayed waveform. Without this, any reading is meaningless.

[7]Read off the displayed oxygen saturation and pulse rate. Be cautious interpreting figures where there has been an instantaneous change in saturation - for example 99% falling suddenly to 85%. This is physiologically not possible.
If in doubt, rely on your clinical judgment, rather than the value the machine gives.

Alarms

If the Low Oxygen Saturation alarm sounds, check that the patient is conscious if that is appropriate. Check the airway and make sure the patient is breathing adequately. Lift the chin or apply other airway manoeuvres as appropriate. Give oxygen if necessary. Call for help.

If the Pulse Not Detected alarm sounds, look for the displayed waveform on the pulse oximeter. Feel for a central pulse. If there is no pulse, call for help, start the procedures for Basic and Advanced Life Support. If there is a pulse, try repositioning the probe, or put the probe on a different digit. On most pulse oximeters, the alarm limits for oxygen saturation and pulse rate can be altered according to your needs. However, do not alter an alarm just to stop it sounding - it could be telling you something important.

V. USES OF PULSE OXIMETRY

[1]Simple, portable "all-in-one" monitor of oxygenation, pulse rate and rhythm regularity, suitable for "field" use. As a safe, non-invasive monitor of the cardio-respiratory status of high-dependency patients - in the emergency department, during general and regional anesthesia, postoperatively and in intensive care. This includes procedures such as endoscopy, where often frail patients are given sedative drugs such as midazolam. Pulse oximeters detect the presence of cyanosis more reliably than even the best doctors when using their clinical judgment.

[2]During the transport of patients - especially when this is noisy - for example in aircraft, helicopters or ambulances. The audible tone and alarms may not be heard, but if a waveform can be seen together with an acceptable oxygen saturation, this gives a global indication of a patient's cardio-respiratory status.

[3]To assess the viability of limbs after plastic and orthopedic surgery and, for example, following vascular grafting, or where there is soft tissue swelling or aortic dissection. As a pulse oximeter requires a pulsatile signal under the sensor, it can detect whether a limb is getting a blood supply. As a means of reducing the frequency of blood gas analysis in intensive care patients- especially in paediatric practice where vascular (arterial) access may be more difficult.

[4]To limit oxygen toxicity in premature neonates supplemental oxygen can be tapered to maintain an oxygen saturation of 90% - thus avoiding the damage to the lungs and retinas of neonates. Although pulse oximeters are calibrated for adult haemoglobin, HbA, the absorption spectra of HbA and HbF are almost identical over the range used in pulse oximetry, so the technique remains reliable in neonates. During thoracic anesthesia - when one lung is being collapsed down - to determine whether oxygenation via the remaining lung is adequate or whether increased concentrations of oxygen must be given.Foetal oximetry- a developing technique that uses reflectance oximetry, using LEDs of 735nm and 900nm. The probe is placed over the temple or cheek of the foetus, and needs to be sterile and sterilisable. They are difficult to secure and the readings are variable, for physiological and technical reasons. Hence the trend is more useful than the absolute value.

VI. LIMITATIONS OF PULSE OXIMETRY

Not a monitor of ventilation A recent case report highlighted the false sense of security provided by pulse oximetry. An elderly woman postoperatively in the recovery room was receiving oxygen by face mask. She became increasingly drowsy, despite having an oxygen saturation of 96%. The reason was that her respiratory rate and minute volume were low due to residual neuromuscular block and sedation, yet she was receiving high concentrations of inspired oxygen, so her oxygen saturation was maintained. She ended up with an arterial carbon dioxide concentration of 280 mmHg (normal 40 mmHg) and was ventilated for 24 hours on intensive care. Thus oximetry gives a good estimation of adequate oxygenation, but no direct information about ventilation, particularly as in this case, when supplemental oxygen is being administered.

- **Critically ill patients** It may be less effective in very sick patients, because tissue perfusion may be poor and thus the oximeter probe may not detect a pulsatile signal.
- **Waveform presence** If there is no waveform visible on a pulse oximeter, any percentage saturation values obtained are meaningless. Inaccuracies Bright overhead lighting, shivering and motion artifact may

give pulsatile waveforms and saturation values when there is no pulse.

Abnormal hemoglobin such as methaemoglobinaemia, for example following overdose of prilocaine, cause readings to tend towards 85%.

Carboxyhaemoglobin, caused by carbon monoxide poisoning, causes saturation values to tend towards 100%. A pulse oximeter is extremely misleading in cases of carbon monoxide poisoning for this reason and should not be used.

Cardiac arrhythmias may interfere with the oximeter picking up the pulsatile signal properly and with calculation of the pulse rate

COMPANY / SPECS	***NONIN***	***SPO***	***PCI***
MODEL	Onyx Vantage 9590	Pulse ox 6100	BCI 3420 Digit
DIMENSION	5.5*3.3*2.2	7.4*4.1*3	5.7*4.3*3.8
RANGE	SP02: 0-100% PULSE RATE: 20-250 BPM	SP02: 40-99% PULSE RATE: 40-250 BPM	SP02: 0-99% PULSE RATE: 30-254 BPM
ACCURACY	SP02: +_ 2 DIGITS PULSE RATE: +_3 DIGITS	SP02: +_ 2 DIGITS PULSE RATE: +_3 DIGITS	SP02: +_ 2 DIGITS PULSE RATE: +_2 DIGITS
BATTERY LIFE	36 hours(cont)	600 hours(cont)	16 hours(cont)
WEIGHT	52gm	50gm	85gm
ENVIRONMENTAL CONDITION	Op.temp:- 5 to 40c Storage:- 40 to 70c	Op.temp:- 4 to 42c Storage:- 39 to 47c	Op.temp:- 0 to 55c Storage:- -40 to 75c
POWER REQUIREMENT	AAAsize alkaline Batteries	3.6V lithium or ½ AA size batteries	2 AAA sized Alkaline batteries
COST	10000 INR	13000 INR	9000 INR

Table 1. Comparative study of Oximeters

From the table1 ,**'NONIN'S ONYX VANTAGE 9590'** is best because of following features**:**
Very much portable, has the best range of Sp02 and pulse rate. This oximeter stable and wide range of operating and storage temperature. The nonin's oximeter is also economical which costs just 10k.
So, when compared with the features nonins oximeter takes over the other two oximeters and would be the best option to go with, who is in need of a Fingertip

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ADDRESSEE FOR CORRESPONDENCE

1. Bhargav
V Semester
Department of Instrumentation Technology
R.V.College of Engineering
Bangalore, India
bhargavmk1@gmail.com

2. Basawaraj
V Semester
Department of Instrumentation Technology
R.V.College Of Engineering
Bangalore, India
basawarajmk@gmail.com

3.Prof.Vidya MJ
Department of Instrumentation Technology
R.V.College Of Engineering
Bangalore, India
vidyamj@rvce.edu.in