Supporting technologies — pulse oximetry

© RWD Nickalls (*retired*),
Department of Anaesthesia,
Nottingham University Hospitals,
City Hospital Campus,
Nottingham, UK.

dick@nickalls.org
www.nickalls.org

FROM: Nickalls RWD. *Notes on thoracic anaesthesia*
http://www.nickalls.org/dick/papers/thoracic/book-thorax.pdf
REVISION: August 2011

9

Supporting technologies

9.3 Pulse oximetry[1]

9.3.1 History

For a detailed review of the long and and fascinating history of blood gases, oximetry and pulse oximetry see Severinghaus (2002; 1986) and Severinghaus and Astrup (1987).

The first practical oximeter was the eight-wavelength ear-oximeter developed in 1964 by Robert Shaw and subsequently marketed by Hewlett-Packard in 1970 (Moyle 1994). In 1971 Takuo Aoyagi (1936–), a Japanese biomedical engineer at the Nihon Kohden Corporation (Tokyo), used the pulsatility of the absorption signal to separate arterial and tissue absorption and determine arterial saturation. Severinghaus describes it thus:

> Takuo Aoyagi ... attempted to eliminate arterial pulsatile 'noise' in his earpiece dye dilution curves by subtracting infra-red signals. He observed that the compensated noise varied with oxygen saturation and realised that it might be used to compute the arterial oxygen saturation.
>
> Severinghaus (1989)

The first commercial pulse oximeter appeared in 1970 (Moyle 1994), and in 1982 the Stanford anaesthetist William New (1942–), with Jack Lloyd and engineer Jim Corenham, founded *Nellcor*[2] *Incorporated* to mass-produce clinically useful pulse-oximeters (Rendall-Baker and Bause 2002).

If a finger pulse-oximeter fails owing to significant peripheral vasoconstriction, then an ear-probe will usually be satisfactory. Alternatively, a digital nerve block may help (Erasmus 2003).

[1] `http://www.nickalls.org/dick/papers/thoracic/hand-pulseox.pdf`

[2] The name 'Nellcor' was derived from a synthesis of the surnames NEw, LLoyd, CORenham (Rendall-Baker and Bause 2002).

- Astrup PB and Severinghaus JW (1986). *History of blood gases, acids and bases.* (Munksgaard, Copenhagen). [from Severinghaus 1989]
- Breathnach CS (1972). The development of blood gas analysis. *Medical History*; 16, 51–62. (http://www.pubmedcentral.gov/picrender.fcgi?artid=1034930&blobtype=pdf)
- Erasmus PD (2003). Digital block improves pulse oximetry signal in vasoconstricted patients. *Anaesthesia*; 58, 1033–1034.
- Kofke WA (2003). An interview with John W. Severinghaus. *Association of University Anesthesiologists (AUA) Update*; Fall 2003 issue. http://www.auahq.org/fall03aua.pdf [an interesting 4 page article in which Severinghaus describes how he became involved in MAC, blood gases and oximetry]
- Moyle JTB (1994). *Pulse oximetry.* (BMJ Publishing Group, London).
- Pole Y (1999). Evolution of the pulse-oximeter. *The History of Anaesthesia Society Proceedings*; 26, 21–22.
- Rendell-Baker L and Bause GS (2002). Cardiorespiratory monitoring: a pictorial sampler. *ASA Newsletter*; 66, No. 9 (September) (http://www.asahq.org/Newsletters/2002/)
- Severinghaus JW (2002). The history of clinical oxygen monitoring. In: Eds. Diz JC, Franco A, Bacon DR, Rupreht J and Alvarez J. *The History of Anesthesia. Proceedings of the Fifth International Symposium on the History of Anesthesia; Santiago, Spain, 19–23 September 2001.* Excerpta Medica, International Congress Series 1242. ISBN:0-444-51293-4 (Elsevier Science). pp. 115–120.
- Severinghaus JW and Astrup PB. (1987). History of blood gas analysis. *International Anesthesiology Clinics*; 25, no. 4, (Little, Brown & Co.., Boston, USA). [first published as a series of articles in *Journal of Clinical Monitoring* in 1986]
- Severinghaus JW (1986). Historical development of oxygenation monitoring. In: *Pulse Oximetry.* Eds. Payne JP & Severinghaus JW, (Springer-Verlag), pp. 1–18 [covers spectroscopy, oximetry and blood gas electrodes]
- Severinghaus JW and Astrup PB. (1986). History of blood gas analysis. VI. Oximetry. *Journal of Clinical Monitoring*; 2, 270–288.
- Severinghaus JW and Honda Y. (1987). History of blood gas analysis. VII. Pulse oximetry. *Journal of Clinical Monitoring*; 3, 135–138.
- West JB (1998). *High life; a history of high-altitude physiology and medicine.* (Oxford University Press).

• Yoshiya I, Shimada Y and Tanaka K (1980). Spectrophotometric monitoring of arterial oxygen saturation in the fingertip. *Med. Biol. Eng. Comput.*; 18, 27–32 [excellent]