Can the Human Oesophagus give adequate PPG Signals for Pulse Oximetry ?

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Pulse oximeter probes placed peripherally may fail to give accurate values of arterial blood oxygen saturation (SpO_2) when peripheral perfusion is poor. Since central blood flow may be preferentially preserved, the oesophagus was investigated as an alternative monitoring site. An oesophageal photoplethysmographic (PPG) probe comprising miniature surface-mount opto-electronic devices and operating at 880nm and 655nm was constructed to fit into a disposable transparent stomach tube (20 French gauge). An electrically isolated signal processing system was developed. The output was digitised and further analysed by a virtual instrument implemented in *Labview* on a laptop computer. Infrared and red AC and DC PPG traces together with an ECG trace were obtained simultaneously and displayed on the laptop screen. We studied 20 healthy (ASA 1 or 2) adults who were scheduled for surgery under general anaesthesia, for which tracheal intubation would be required. The PPG probe was inserted into the mid-oesophagus at laryngoscopy. An identical probe was placed on a finger, and signals from each were processed and displayed on a laptop computer, using the same gain characteristics for each channel. In 13 further patients, we compared the amplitudes of the PPG signals at five different depths in the oesophagus (30, 25, 20, 15 cm, measured from the upper incisor teeth) to determine an optimal position for reliable SpO_2 monitoring. In all patients, we were able to record PPGs with good signal-to-noise ratio from the length of the oesophagus. The amplitudes of the oesophageal PPGs are on average approximately three times larger than those obtained simultaneously from a finger, although there is considerable variability. The PPG signals in the mid to lower region of the oesophagus on average had larger amplitudes at both red and infrared wavelengths than the PPGs recorded in the upper oesophagus. The red and infrared wavelengths used are suitable for pulse oximetry, and these results justify further studies to evaluate the lower oesophagus as a potential site for blood oxygen saturation monitoring in patients with poor peripheral perfusion.

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