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INVESTIGATION OF PHOTOPLETHYSMOGRAPHIC SIGNALS IN NEONATAL AND PAEDIATRIC PATIENTS

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INTRODUCTION. Pulse oximeters are widely used in paediatric intensive care but they have some severe limitations. The technique relies on the presence of adequate peripheral arterial pulsations, which are detected as photoplethysmographic signals (PPG). When peripheral perfusion is poor as in states of hypovolaemia, hypothermia and vasoconstriction oxygenation readings become extremely unreliable. Hence, pulse oximetry becomes unreliable in a significant group of children just at the time when accurate readings are most needed. To overcome this limitation, the oesophagus has been investigated as a potential measurement site on the hypothesis that perfusion may well be better preserved at this central site. Studies on adult patients have shown that measurable PPG signals at red and infrared wavelengths can be detected within the whole depth of the oesophagus. A new system to investigate the quality of oesophageal PPG signals is being constructed with the aim of developing a neonatal and paediatric oesophageal pulse oximeter.

METHODS. A reflectance optical sensor has been constructed comprising miniature infrared and red emitters and a photodetector. The sensor was design to fit into a conventional disposable transparent stomach tube, 12 French gauge. The oesophageal PPG sensor within the stomach tube was inserted through the nose into the oesophagus of a 2 kg, 17 day old neonate. The stomach tube was advanced into the oesophagus under direct vision until the probe was 25 cm from the nose. PPG traces from the oesophagus were recorded for approximately 5 minutes at this depth on a laptop computer. Measurements were repeated at 20 and 15 cm from the nose.

RESULTS. Measurable PPG traces of good quality were obtained in the oesophagus at all three depths. 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. Artefacts on both wavelengths due to oscillations as a result of high frequency ventilation. Filtering successfully eliminates the artefact.

CONCLUSION. The new oesophageal reflectance optical sensor has allowed PPG measurements to be made within the whole length of the neonatal oesophagus. The red and infrared wavelengths used are suitable for pulse oximetry. These results are the first to demonstrate that pulse oximetry may be feasible in the neonatal or paediatric oesophagus. Further studies are required to develop a neonatal/paediatric pulse oximeter.

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