Reflectance Photoplethysmography as Non-Invasive Monitoring of Tissue Blood Perfusion.

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In the last decades Photoplethysmography (PPG) has been used as noninvasive technique for monitoring arterial oxygen saturation by Pulse Oximetry (PO), whereas Near Infrared Spectroscopy (NIRS) has been employed for monitoring tissue blood perfusion. While NIRS offers more parameters to evaluate oxygen delivery and consumption in deep tissues, PO only assesses the state of oxygen delivery. For a broader assessment of blood perfusion, this paper explores the utilization of dual-wavelength PPG by using the pulsatile (AC) and continuous (DC) PPG for the estimation of arterial oxygen saturation (SpO2) by conventional PO. Additionally, the Beer-Lambert law is applied to the DC components only for the estimation of changes in deoxy-hemoglobin (HHb), oxy-hemoglobin (HbO2) and total hemoglobin (tHb) as in NIRS. The system was evaluated on the forearm of 21 healthy volunteers during induction of venous occlusion (VO) and total occlusion (TO). A reflectance PPG probe and NIRS sensor were applied above the brachioradialis, PO sensors were applied on the fingers, and all the signals were acquired simultaneously. While NIRS and forearm SpO2 indicated VO, SpO2 from the finger did not exhibit any significant drop from baseline. During TO all the indexes indicated the change in blood perfusion. HHb, HbO2 and tHb changes estimated by PPG presented high correlation with the same parameters obtained by NIRS during VO (r2=0.960, r2=0.821 and r2 =0.974 respectively) and during TO (r2=0.988, r2=0.940 and r2=0.938 respectively). The system demonstrated the ability to extract valuable information from PPG signals for a broader assessment of tissue blood perfusion.