

Pilot Study: Utilizing Finger Pulse Oximetry Waveform for Evaluating Endothelial Function

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Introduction: Endothelial dysfunction (ED) is a shift in the vascular endothelium towards vasoconstriction, producing a prothrombotic and pro-inflammatory state. ED is associated with cardiac disease, PVD, DM, and stroke; thus, it is important to screen for ED. The present non-invasive gold standard for assessment is Flow Mediated Ultrasound (FMD), but it is operator dependent, thus, peripheral arterial tonometry (PAT) is the next best method as it is operator independent.

We aim to assess endothelial function using finger pulse oximetry -photoplethysmographic (PPG)- waveforms. Pulse oximeters are cheaper and more readily available.

Methods:

Study Population: With IRB approval, the study was conducted in two parts; part #1 involved 12 healthy subjects, and part #2 involved 10 patients having endothelial dysfunction.

PAT is a non-invasive technique that measures changes in digital blood volume during post ischemic reactive hyperaemia (RH).

Pulse oximeter testing involved placing a probe on a digit in both hands. The RH test started with baseline readings for 6 mins, then the BP cuff was inflated above systolic pressure for 5 mins and then released where a reading of RH was taken for 5 mins.

Data Analysis:

PAT: The software analyses the data and calculates the RH Index (RHI) and its natural logarithm (LnRHI).

LnRHI scores of 0.51 indicates the cut-off point, where values below 0.51 are regarded as having ED.

Pulse oximetry (PPG) waveform processing: We used a high-pass filter of 2 Hz to eliminate the venous modulation of the waveforms. PPG RHI and LnRHI were calculated similarly to PAT.

Results: Comparing the readings of finger PPG to those of PAT established a cut-off point of PPG LnRHI > 0.40.

Part #1: In healthy subjects; 11 showed normal values of PAT LnRHI (above 0.51), with only one subject (#12) who had LnRHI of (0.32). The same was observed with PPG LnRHI. All subjects were above the critical level of (0.4), except subject #12.

Part#2: In patients; the same agreement between the PAT and PPG LnRHI was observed. (Figure 1).

Correlation of PAT LnRHI and PPG LnRHI for all subjects (n=22), $r = 0.713$, $p < 0.01$ (figure 2).

Conclusion: When we consider the availability of pulse oximeters, we can see that if they were manufactured with the preceding calculations applied, they would be able to predict

conditions of endothelial dysfunction. Further trials need to be conducted to strengthen this statement.

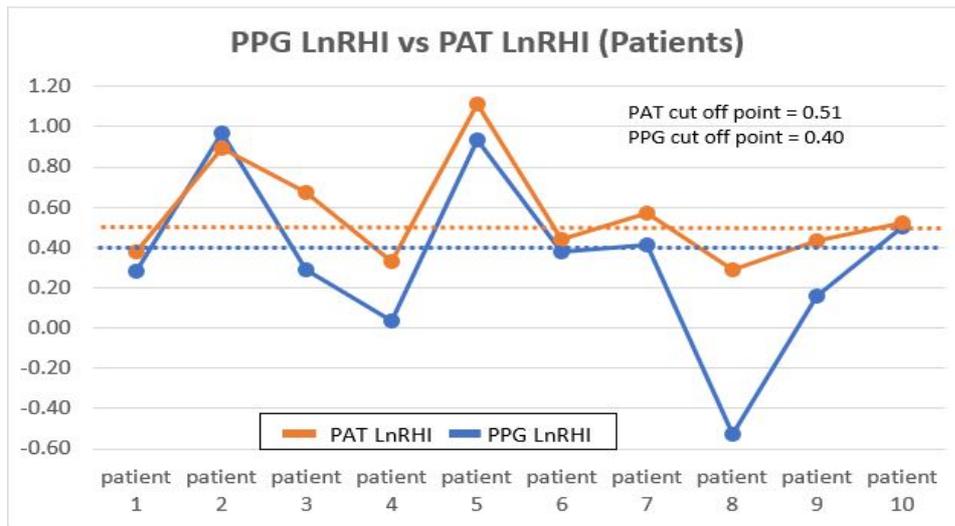


Figure 1 – Graph illustrating the comparison of the PPG and PAT LnRHIs of the Patient group, also delineating a cut-off point of 0.40 for the PPG device