Pulse Transit Time from Seismocardiography as an Estimation of Blood Pressure

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Aims: A new method of predicting cuff-less blood pressure (BP) is by using pulse transit time (PTT). Proposed techniques involve estimating PTT by measuring the time delay between a proximal and distal site and then calibrating the interval to BP. Current literature is inconsistent on best practice as each study uses a different PTT estimation or optimized BP model. The industry standard ECG R-peak to distal pulse-onset interval is a measurement of pulse arrival time (PAT), not pulse transit time due to the pre-ejection period. A rising method, seismocardiography (SCG), can be used for a better PTT estimation as it records the mechanical motion of the heart and valves. This paper aimed to assess the relationship of BP and PTT by exploring a range of models and intervals within the same dataset.

Methods: 50 healthy subjects were recruited for the study. Concurrent seismocardiography, electrocardiography, photoplethysmography (PPG), and continuous finger-cuff blood pressure were monitored. 12 PTT estimations were considered by a combination of 3 proximal time points (ECG R-peak, SCG aortic opening, and SCG isotonic contraction) and 4 distal time points (PPG peak, PPG foot, PPG derivative peak, PPG tangent intersection). BP was estimated using 10 different models to relate blood pressure to PTT.

Results: Linear correlation of BP predictions were demonstrated over all input indicators and models. Logarithmic models had the best relationship with BP when compared across all PTT indicators. ECG R-peak had significantly worse performance than SCG when using PTT for BP estimation. The time interval between the SCG isotonic contraction and the maximum point of the PPG derivative proved to be a better indicator of blood pressure independent of the model.

Conclusion: Logarithmic models with SCG proximal timing showed comparable BP estimation results, indicating that SCG-based PTT estimation has a better relationship with BP than current methods.