Long Term Doppler Signal Acquisition and Rapid Signal Characterization for a Peripheral Flow Assessment System

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Objective: Test a combined ultrasound Doppler, and photo-pulse-plethysmography peripheral vascular device for long term signal acquisition, using a custom built data logging interface and Doppler ultrasound probe holder. Demonstrate feasibility of performing simple Doppler waveform analyses on radial and dorsalis pedis arteries over several minutes, during controlled physiological provocations.

Methods: Upper and lower extremity flow in real time is recorded using a clinical system (VISTA, Summit Doppler, Colorado), adapted to interface with a computer. The ultrasound Doppler probe is coupled to relevant artery by a customized holder, and artifact free Doppler signal is acquired. A first order signal assessment is performed by measuring overall peak-to-peak (pk-pk), negative and positive Doppler signal amplitudes, respectively. For two normal subjects, the Doppler ultrasound probe was attached sequentially, to radial or the dorsalis pedis. For upper limb evaluation, subjects were instructed to lay supine (quiescent phase); then raise their arm vertically upwards; followed by occlusion of the forearm using a blood pressure cuff. The lower limb signal was recorded during subject lying supine; followed by placing the lower extremities in Trendelenburg position; and occlusion at the calf level. Rapid analyses of acquired Doppler signals was performed.

Results: During quiescent phases, radial and dorsalis pedis Doppler waveforms are differentiable, with lower dorsalis pedis pk-pk values. Post-occlusion, transient hyperemia is noted in both upper and lower limbs. Compared to quiescent phase, when raising forearm, Doppler signal showed an overall decrease, while Trendelenburg phase resulted in an increased arterial backflow, with shifted signal baseline. During physiological provocations, Doppler signals were reliably recorded without signal distortion.

Conclusions: A clinical peripheral vascular Doppler system is adapted for real time data logging. Attaching the spectral Doppler probe to the forearm or foot using a custom built fixture allows signal recording during various physical procedures. Online data analysis provides a quick flow assessment capability to the clinician.

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