Postextrasystolic potentiation detection with photoplethysmography from the wrist – A preliminary study

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Introduction
Postextrasystolic potentiation (PESP) is a phenomena that has been studied for more than 100 years and it means an increase in the contractility of the heart beat following an extrasystolic beat [1]. PESP has been attributed to altered Ca2+ homeostasis and several studies have reported an enhanced PESP in heart failure patients. For the heart failure patients, the underlying cause might be the disruption of normal Ca2+ handling. PESP is usually measured with invasive methods, such as using the first derivative of the left ventricular pressure as a measure of contractility. [2]
We propose a non-invasive method to evaluate the presence of PESP after a spontaneous extrasystolic beat by measuring photoplethysmogram (PPG) from the wrist. A wrist-worn device can be used for long-term monitoring and therefore used for detecting deterioration or improvement in the patient’s state.

Methods

Data
- 7 patients (age: 63 ± 17 y, 5 males) undergoing a 24h-Holter measurement and experiencing premature ventricular contractions (PVCs) during the night
- Simultaneous 12-lead electrocardiogram (ECG) and PPG recordings
- Accelerometer measurement for movement detection

Analysis
- Pulse extraction
- PVC sequence extraction (PVC, 8 preceding beats, 1 consecutive beat)
- Sequences with movement artifacts or irregularities discarded
- Steepness of the pulse slope used as an indicator of contractile force [3]

Results

- 1 patient was excluded from the study due to artifacts in all the PVC sequences
- For two patients no increase in the steepness of the PPG pulse slope [0.96 and 0.99] for the beat following the PVC
- For four patients there was an increase [1.21 ± 0.15] of the steepness of the slope which could indicate the presence of PESP

Conclusions
- Photoplethysmographic measurement provides promising means to detect PESP non-invasively from the wrist
- Further studies are needed to confirm these findings

References