Using wearable photoplethysmography for detecting atrial fibrillation in ambulatory conditions

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Background and Aim: Atrial fibrillation (AF) is a common cardiac arrhythmia, and its prevalence increases strongly with age. AF is known to promote atrial thrombosis, which may lead to ischemic stroke. Common symptoms of AF include general fatigue, dizziness, shortness of breath, rapid heartbeats, and fluttering feeling in the chest, but AF may also be asymptomatic. Especially identifying the patients with subclinical silent AF is a challenge. Detecting beat-to-beat intervals from photoplethysmography (PPG) data measured from the wrist and combining this information with other parameters extracted from the PPG, could enable the detection of AF and other cardiac arrhythmias. This would enable a wearable, unobtrusive solution suitable for long-term monitoring of cardiac and other patients.

Methods: 30 patients (15 female, 15 male; 28-83 years old, mean: 59) were recruited for the study at the Tampere University Heart Hospital. Ten subjects had paroxysmal AF, ten had other arrhythmias, such as irregular SA node activity and first-degree AV block, and ten had normal sinus rhythm during the measurement period. The subjects were wearing a wrist-worn prototype PPG monitor by PulseOn company for 48 hours outside the hospital in normal daily conditions. A reference ECG was collected using Faros 360 Holter monitor by Bittium Biosignals. The study was approved by the local ethical committee of the university hospital.

Approximately 1200 hours of PPG data was collected from which the inter-beat-interval (IBI) and signal quality information were estimated and further used to detect AF in 5-minute intervals.

Results: Of the 5-minute segments 37.3% were considered to have bad signal quality due to, for example, movement artifacts, with the ratio being higher during the day and lower during the night. After discarding the inadequate quality segments, an accuracy of 96.7%, a sensitivity of 89.8% and specificity of 97.4% for detecting atrial fibrillation were achieved.