Atrial fibrillation can be diagnosed using a combined wrist-worn photoplethysmography and electrocardiography

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Background: Current ESC Clinical Practice Guideline for management of atrial fibrillation requires a minimum of 30-seconds of atrial fibrillation (AF) to be visually confirmed from an electrocardiography (ECG) recording for diagnosis. Single-channel ECG recorded from any measurement lead is sufficient. The current method of 24-48 h Holter ECG may not detect rarely occurring AF episodes, and thus extended duration recording devices are needed. Intermittent portable ECG devices intended for clinical use exist but those lack continuous rhythm monitoring and are thus unable to notify the user in case of asymptomatic episode.

Purpose: We evaluated the performance of a wrist-worn solution (Fig. 1) intended for clinical use that combines continuous photoplethysmography (PPG) -based rhythm assessment with intermittent ECG measurements in the detection of atrial fibrillation in ambulatory conditions.

Methods: 30 adult patients with previous diagnosis of AF were recruited for 48-hour measurements. Simultaneous 5-lead Holter monitoring was used as the reference. The patients were taking intermittent ECG measurements at pre-scheduled times (4 times a day), when notified by the device (irregular rhythm detected by PPG), and if feeling symptoms of AF.

Results: The obtained sensitivity and specificity for PPG-based AF detection were 95.5% and 99.2%, respectively when evaluated in 5-minute segments. Only the segments during which adequate amount, approximately 30-seconds, of good quality PPG data was available, were considered in the analysis. On average this equals 54% of the segments.

Patients took in total 456 30-second ECG measurements. Out of these 411 and 392 were assessed as analysable quality by ECG algorithm and visually by two cardiologists, HS and KK, respectively. Automatic ECG analysis algorithm labelled ECG measurements taken during atrial fibrillation correctly as “Possible arrhythmia” with 95.7 % sensitivity and 92.0 % specificity. 99.5% of the analysable quality ECGs measured during AF were marked with any type of label e.g., tachycardia that highlights them to the clinician. An example ECG measurement with markings of the analysis algorithm an overall classification is shown in Fig. 2. All patients having AF during the 48-hour monitoring (14/30) were correctly identified based on the wrist device data.

Conclusion: Based on the obtained results, wrist-worn device combining continuous PPG and intermittent ECG measurements can be reliably used in detecting atrial fibrillation in ambulatory conditions. The user-friendliness and unobtrusiveness of wrist-worn technology enables virtually unlimited monitoring time thus facilitating the detection of rarely occurring AF episodes. The information of continuous rhythm monitoring can also be used for the estimation of AF burden. The solution used in the study has received medical device CE certification in early 2022.

Figure 1. Wrist-worn arrhythmia monitoring device used in the study.

Figure 2. Example view of doctor's data analysis tool showing the result of automatic ECG analysis in the top left corner.

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