Evaluation of the device independent nature of a photoplethysmography-deriving smartphone app

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Background

Smartphone apps using photoplethysmography (PPG) technology enable digital heart rhythm monitoring through their built-in camera, without the need for additional, specific, or costly hardware. This may positively impact the availability and scalability of remote monitoring. However, the diversity of smartphone specifications on the consumer market may raise concerns regarding the robustness of AF detection algorithms between various devices.

Purpose

To study the device independency of AF detection performance by a PPG-based smartphone application.

Methods

Patients from the cardiology department were consecutively enrolled. Patients were handed 7 iOS models and 1 Android model and were asked to consecutively perform one PPG measurement per device. A 12-lead electrocardiogram (ECG) was collected during the same consultation and interpreted by a cardiologist as reference diagnosis. To allow an objective comparison across the devices, patients who failed to perform one successful measurement on each device were excluded. Additional exclusions were atrial flutter rhythms and insufficient quality results. Sensitivity, specificity and accuracy were calculated with respect to the reference diagnosis. McNemar's analysis was used for the head-to-head comparison of the sensitivity and specificity of the proprietary algorithm on the different smartphone devices.

Results

A total of 150 patients participated in the study with a median CHA2DS2-VASc score of 3 (interquartile range: 1-5). The median age of the study population was 70 (interquartile range: 56-79) years. In total, 54.7% of the population was male and the AF-prevalence was 35.3%. After the exclusion of patients with atrial flutter (n = 14) and patients who did not successfully perform a PPG measurement on each device (n = 5), diagnostic-grade results of 131 patients were used to calculate the performance of the proprietary algorithm. The sensitivity and specificity of the AF detection algorithm ranged from 90.9% (95% CI 75.7-98.1) to 100.0% (95% CI 91.0-100) and 94.5% (95% CI 86.6-98.5) to 100.0% (95% CI 94.6-100), respectively. The overall accuracy across the devices ranged from 94.4% (95% CI 88.3-97.9) to 99.0% (95% CI 94.6-100). Head-to-head comparisons of the results did not reveal significant differences in sensitivity (P = 0.125-1.000) or specificity (P = 0.375-1.000) of the proprietary AF detection algorithm among the different devices.

Conclusion: This study demonstrated the device-independent nature of the PPG-deriving smartphone application with respect to 12-lead ECG diagnosis.