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The diagnostic accuracy of a pulse-deriving smartphone application is device independent

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Introduction

Smartphone applications using photoplethysmography (PPG) technology through their build-in camera are becoming an attractive alternative for atrial fibrillation screening due to their low cost, convenience, and broad accessibility. However, some important questions concerning their diagnostic accuracy and device independent nature remain to be answered.

Objective

This study evaluated the diagnostic accuracy of a PPG-based pulse-deriving smartphone application with respect to handheld single-lead ECG and the gold standard, 12-lead ECG. In addition, the device dependent nature of the performance of the application was assessed.

Methods

Patients who were scheduled for a regular consultation or procedure (i.e. ablation or cardioversion) were recruited from the cardiology ward. Additionally, patients hospitalized for continuous cardiac monitoring were recruited to enrich the database with atrial fibrillation (AF) measurements. After obtaining written informed consent, patients filled in a questionnaire collecting demographic and medical information. Patients were handed 6 Android and 2 iOS devices and were asked to perform one PPG-measurement per device. They also performed a single-lead ECG measurement with a handheld device. Subsequently, a 12-lead ECG was taken to obtain a reference diagnosis.

Results

A total of 150 patients participated in the study. The mean age of the study population was 64 (±19) years, 58% was male. The AF-prevalence was 37%. On average, patients in AF had a higher CHA2DS2-VASc score; 3.93 (±1.80) compared to 2.02 (±1.63) for non-AF patients.

The amount of insufficient quality measurements recorded with the pulse-deriving smartphone application ranged from 4% (iOS) to 13% (Android). Averaged for all the smartphone devices, the pulse-deriving application scored 87.7% (±3%) sensitivity, 96.6% (±3%) specificity, 77.2% (±5%) NPV, 98.3% (±1%) PPV, and 90.3% (±2%) accuracy. The handheld single-lead ECG device had 87.6% sensitivity, 91.5% specificity, 78.2% NPV, 95.5% PPV, and 88.9% accuracy.

The same calculations were preformed after excluding regular atrial flutter measurements. On average, the pulse-deriving application scored 94.8% (±1%) sensitivity, 96.1% (±3%) specificity, 88.1% (±3%) NPV, 98.3% (±1%) PPV, and 95.2% (±1%) accuracy. The handheld single-lead ECG device had 95.5% sensitivity, 90.2% specificity, 90.2% NPV, 95.5% PPV, and 93.9% accuracy.

Conclusions

The diagnostic accuracy of the pulse-deriving smartphone application and the handheld single-lead ECG device was strongly influenced by the presence of regular atrial flutters, stressing the importance of further thorough validation. For the pulse-deriving smartphone application, there was no significant influence from device type in
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