Smartwatch-based detection of atrial arrhythmia using a deep neural network in a tertiary care hospital

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BACKGROUND

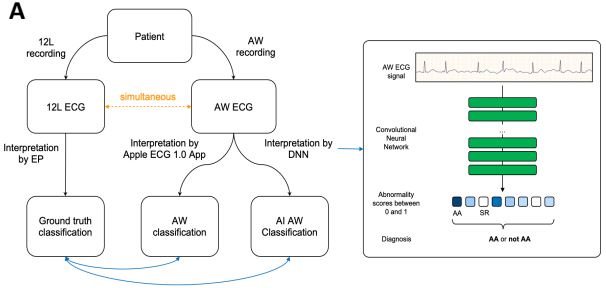
- Smartwatch electrocardiograms (SW ECG) are a promising non-invasive solution to assess heart rhythm abnormalities, especially atrial arrhythmias (AA).
- This study evaluates the performance of the detection of AA, which includes atrial fibrillation, atrial flutter and supraventricular tachycardia with a smartwatch (Apple Watch) and reports the accuracy of:
  - a novel deep neural network (DNN) -based algorithm;
  - the original companion application, Apple ECG 2.0 App

  in a population typical of an electrophysiology department.

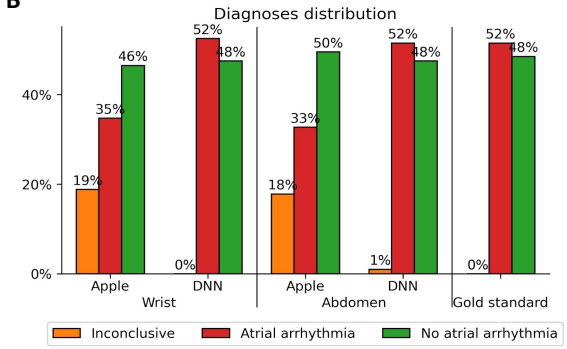
METHODS

- 101 patients from the electrophysiology department of one tertiary center were included.
- 3 simultaneous ECGs were collected for each patient:
  - 1 12-lead ECG (Mindray BeneHeart R12)
  - 2 SW ECGs (Apple Watch Series 4)
    - from the left wrist (SWw ECG)
    - from the lower left abdomen (SWa ECG)
- 12-lead ECGs were adjudicated by a blinded expert electrophysiologist as 52 AA and 49 not AA (gold standard).
- The SW ECGs were processed by the ECG 2.0 App and the DNN in parallel (Figure A).
- The **proportions of inconclusive diagnoses** returned and the **performances** were assessed and compared.

A



B



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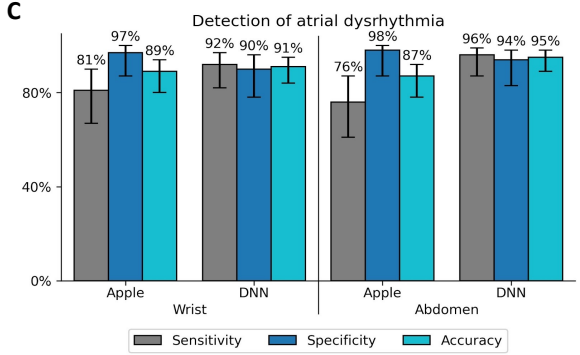

RESULTS

- For SWw ECGs, proportions of inconclusive diagnoses were:
  - Apple: 19% (19/101).
  - DNN: 0% (0/101)
- A similar result holds for SWa ECGs (Figure B).
- Regarding the detection of AA from SWw ECGs (Figure C):
  - Apple
    - sensitivity: 81% (95% CI, 67%-90%)
    - specificity: 97% (95% CI, 87%-100%)
    - accuracy: 89% (95% CI, 80%-94%)
  - DNN
    - sensitivity: 92% (95% CI, 82%-97%)
    - specificity: 90% (95% CI, 78%-96%)
    - accuracy: 91% (95% CI, 84%-95%)
- For SWa ECGs (Figure C), the sensitivity of the DNN was found significantly higher compared to Apple:
  - DNN: 96% (95% CI, 89%-98%)
  - Apple: 76% (95% CI, 61%-87%)

CONCLUSION / DISCUSSION

- **A novel DNN algorithm decreased the number of inconclusive diagnostics in the detection of AA from SW ECG** from 19% to 0%, which could help limit the overreading time spent by the physicians.
- **We observed no significant difference in performance between the two algorithms** except for the sensitivity for SW ECG taken from the abdomen where the DNN outperforms the ECG 2.0 App.
- Routine application of this SW ECG analysis in tertiary care hospitals offers significant promise in arrhythmia diagnosis.

DISCLOSURE INFORMATION

- Laurent Fiorina: Cardiologs medical expert
- Baptiste Lefebvre, Christophe Gardella, Christine Henry: Cardiologs employees.