Prospective Analysis of Utility of Signals from an ECG-Enabled Stethoscope to Automatically Detect a Low Ejection Fraction Using Neural Networks Trained from the Standard 12-Lead ECG

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Abstract

ECG-enabled stethoscopes (ECG-steth) can acquire single lead ECGs during cardiac auscultation, and may facilitate real-time screening for pathologies not routinely identified during physical examination (eg, arrhythmias). We previously demonstrated an artificial intelligence (AI) algorithm applied to a 12-lead ECG (ECG-12) can identify low ejection fraction (EF) (defined as $\leq 35\%$) with an accuracy of 87%. It is unknown if AI algorithms trained from ECG-12 can be applied to single lead ECGs acquired through devices such as ECG-steth. To demonstrate that an AI algorithm trained using ECG-12 can be applied to ECG-steth for detection of low EF.

Methods

100 patients referred for echocardiography were included. In addition to transthoracic echocardiogram, ECG-steth with patient supine and/or sitting were obtained in standard positions where cardiac auscultation is done and via a hand-held lead I equivalent (Figure A&B). An AI algorithm trained on 35,970 independent patients with pairs of ECG-12 and echocardiograms was retrained using a single lead from ECG-12 and validated against ECG-steth to determine accuracy for low EF detection ($\leq 35\%$ or $< 50\%$).

Figure 2

Panel A:

Area under the curve of the receiver operating characteristic for detection of EF $\leq$ 35 and EF $<$ 50 using the optimal Lead (Selected automatically)

Panel B:

The five lead positions used for recording the ECG during the study

Results

Amongst 100 patients (age 70.6 ± 13.8 ; 61% male), 7 had EF $\leq 35\%$ and 7 had EF 35-50%. The best single recording position was V2-V3 with patient supine (area under the curve [AUC] 0.88 [CI:0.80-0.94] for EF $\leq 35\%$ and 0.81 [CI:0.72-0.88] for EF $< 50\%$). When considering best overall lead of all recordings (selected automatically), AUC was 0.906 [CI:0.831-0.955] for EF $\leq 35\%$; 0.841 [CI:0.754-0.906] for EF $< 50\%$. (Figure A&B)

Conclusions

In a prospective study, an AI algorithm reliably detected low EF from single lead ECGs acquired using a novel ECG-enabled stethoscope in standard auscultation positions. The ability to identify patients with a possible low EF during routine physical examination may facilitate rapid clinical recognition of patients requiring further testing such as echocardiography.

References

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