radcliffe cardiology

Title: EHRA 24: Cardiologs: EKG Diagnostic Performance of Smart Watch
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Dr Laurent Fiorina

"So, Laurent Fiorina, I work as an EP in Paris and I will show my work about unmasking conduction tissue disease with an AI-enabled single lead ambulatory ECG.

The Importance of This Study

For the importance of this study, imagine that you have a patient coming to you days after a syncope and the telemetry and the ECG are normal. Now imagine that you can process a few hours of ECG recordings and the AI model can tell you your patient has had complete AV block in the previous week. So, syncope is a frequent condition and we know that it's challenging and time-consuming to make the diagnosis. There is an effort with my team to develop what we call ECG digital biomarkers. Those are AI models that use ECG to do basically two things: to detect a cardiac condition like a structural heart disease, and secondly to predict a future occurrence of a cardiac event like atrial fibrillation or ventricular tachycardia from a normal or apparently normal ECG. And so the back-to-the-future concept was inspired by the challenge we face when we have a patient who experienced a prior syncope in the prior hours or days. And what we would really like to do is to record the ECG in the past, to look back into the past, to record the ECG at the precise moment and not when it is too late. And we had the intuition that AI could be that time machine by decoding electrical markers that are the footprint of conduction tissue disease. With ambulatory ECG, we could detect the structural abnormalities, but also the dynamic changes that reflect the conduction tissue fragility and the autonomic nervous system.

About Cardiologs

So, Cardiologs is an AI ECG analysis med tech founded in 2014 and acquired by Philips in 2021. The Cardiologs dataset contains more than 3.5 million different ECG

recordings. And the first thing we done is an AI ECG analysis platform for arrhythmia analysis. And now our last focus is developing those new AI models to predict a cardiac condition or a future of cardiac events like atrial fibrillation or ventricular tachycardia.

Study Methodology

So, upon 1.4 million different ambulatory ECG, whatever the indication, after excluding the ambulatory ECG under two weeks and without asystolic pause, we finally worked on 340,000 ambulatory ECG of two weeks from six different diagnostic facilities in the US. The mean age was 60.5 years old and 60% was female. We then split it into three datasets. The development dataset for the model training, the internal dataset for the performance assessment, and then the external validation dataset, which is important because it is an independent dataset to show how the algorithm generalizes in a different population with different devices that have not been used in the development dataset. So we take the two weeks of the recordings and the input of the algorithm is the last 24 hours without any asystolic pause and we then annotated each recording whether there is or not a systolic pause in the first 13 days and we use it as output. So the output was either complete AV blocks, daytime sinus pause of more than 3 seconds or any time pause of more than 6 seconds and the composite of it.

Key Findings

Well, our key finding is that we reached an AUC for the composite endpoint, which is AV block and sinus pause, we reached an AUC of 0.89 with a consistent result in the external dataset which shows the generalizability of it. And we can look more precisely into the mechanism with the performance of the prediction of daytime sinus pause of more than 3 seconds, anytime pause of more than 6 seconds, and complete AV block. And for complete AV block we have a sensitivity and specificity of 81% and 72%. And we can adjust this threshold on the ROC curve to get a higher sensitivity or higher specificity. And it's not perfect. Certainly not. But if I may remind you the performances of the EP study which is still in the guidelines and is invasive, we have a sensitivity and specificity of 15% and 75%. Well, we have here a new strong predictive model, but still it does not give a definitive diagnosis. But this is the case for many tools we use in

medicine, especially for syncope management. Then we still have work to do because cardiac cause is not the only cause of syncope. Then as we identified complete AV block and sinus node disease, we still don't know the organic or reflex nature of it and then we will need prospective studies to extensively validate the model.

Future Perspectives

And for the perspective, obviously, the first perspective is to improve the patient outcome with a non-invasive diagnostic of the syncopic cause to avoid future risk with an early treatment strategy. And outside of the syncope, we could use this model to make a risk stratification for patients having bundle branch blocks, which one is at risk of developing complete AV block and in what time frame? Then this is a possibility to improve the emergency department triage with the telemetry for rule-in or rule-out and to avoid unnecessary hospitalization or readmission. And then we can imagine to combine this AI model with other AI ECG tools like prediction of unskilled cardiac detection of structural heart disease, and to combine it with also the clinical context, the lab exam, and the imaging.

Conclusion

So my key take-home message is that with an AI-enabled single lead ECG, we can unmask conduction tissue disease. And this is a hope for a better management of our patients who experience syncope. And also it's a hope to reduce preventable morbidity and mortality.