An Ingenious Application of 12 Lead Smartphone ECG for Automatic Implantable Cardioverter-Defibrillator Implantation

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Abstract

The absence of a prehospital 12-lead electrocardiogram can cause definitive treatment delay and repeated transfer. There are already a number of wearable devices that can additionally record a lead electrocardiogram (ECG) and it is reasonable to expect this technology to become a standard feature, as is already the case with automated heart rate tracking. This could potentially have enormous impact regarding the early diagnosis of several cardiac diseases. We present this case of a 30-year-old man who was diagnosed with ventricular tachycardia episode. After the patient was hospitalised, amiodarone treatment caused his ventricular tachycardia to return to NSR. The results of a subsequent 2D-ECHO suggested cardiac sarcoidosis and showed the characteristic patterns of global longitudinal strain patterns and localised wall motion abnormalities. A rise in ACE levels was also detected. The patient had an Automatic Implantable Cardioverter-Defibrillator (AICD) placed after the device consistently recognised bouts of ventricular tachycardia despite optimal medical care. Later, the ECG performed was suggestive of Wide QRS determining of VT (LBBB Type) that depicted the monomorphic pattern on the graph. After the AICD was implanted, the patient underwent routine follow-up using a 12-lead smartphone-based ECG. The device's report for follow-up reveals a normal ECG rhythm. While the potential of ECG recordings by devices to detect ventricular tachycardia is currently under scientific investigation, this case highlights the possible potential of these devices to detect ventricular tachycardia.

Keywords: AICD • Case report • ECG • Ventricular tachycardia

Introduction

Three or more consecutive beats occurring at a rate more than 100 beats per minute are indicative of the ventricular arrhythmia known as Ventricular Tachycardia (VT). Sustained ventricular tachycardia is VT that lasts for more than 30 seconds or that requires treatment because it causes hemodynamic alterations within 30 seconds. 12.72 people with cardiovascular illness were participated in a recent research spanning 12 Indian cities, and 4.5% of them had ventricular tachycardia [1]. Premature, unforeseen cardiovascular deaths have a severe detrimental impact on public health and result in the loss of years of potentially productive life [2].

According to a comprehensive review of 60 researches that links the years of productivity loss in patients with CVD, the productivity losses across studies reflect the availability of more effective drugs and differences in clinical practise between nations and situations [3-8]. This case study also emphasises the repercussions of the illness. Contrarily, non-sustained ventricular tachycardia (NSVT) lasts less than 30 seconds and has no negative effects on hemodynamic. Clinical manifestations of ventricular tachycardia (VT) vary and include palpitations, chest pain, shortness of breath, syncope, and cardiac arrest [9, 10]. Sarcoidosis is a multisystem granulomatous illness with an uncommon occurrence of heart involvement and an unexplained aetiology that predominantly affects the lungs, skin, eyes, and lymph reticular system [11-13].

According to a recent study, cardiovascular involvement is one of the least common symptoms of sarcoidosis, with a 2% frequency. Both the pulmonary sickness that is accompanied by asymptomatic systemic sarcoidosis and the sarcoidosis itself may have cardiac involvement. Nearly 40% of sarcoidosis patients have clinically significant cardiac symptoms such congestive heart failure, heart block, ventricular arrhythmia, or sudden death, yet only about 25% of sarcoidosis patients demonstrate cardiac involvement at autopsy [14,15]. The detection of ventricular anomalies by the 12 Lead ECG Point of Care Device under discussion has been verified.

When investigating the Qtc interval in arrhythmias, a laborious observation that was made with high precision utilising 12-lead smartphone ECG equipment, the device was verified for its efficacy in identifying ventricular and atrial arrhythmias. The goal of this case study is to demonstrate the value of a 12-Lead Smartphone ECG equipment in identifying potentially deadly cardiac arrhythmias. The youthful population is affected by cardiac sarcoidosis and other recognised structural heart diseases.

The utility of the smartphone ECG device was evaluated in terms of: a) Point of Care Device; b) Disease Management and Progression; c) Early Detection Reduced Triage Time; d) Portable device Validation; and e) Assisting in Decision Making, for a period of 10 months before the surgery for implantation was carried out and even after. It is critical to publish written biomedical research addressing these devices' diagnostic accuracy, repeatability, or value since the number of these devices is increasing.

Case report

A 30-year-old man complained of regular palpitations when he went to the Lala Lajpat Rai Memorial Medical College's cardiology outpatient department in Meerut. Upon investigation, it was discovered that he was having a ventricular tachycardia episode. After the patient was hospitalised, amiodarone treatment caused his VT to return to NSR. The results of a subsequent 2D-ECHO suggested cardiac sarcoidosis and showed the characteristic patterns of global longitudinal strain patterns and localised wall motion abnormalities. A rise in ACE levels was also detected.

Based on these results, a cardiac MRI was performed, and it revealed typical LGE patterns, supporting the diagnosis. The patient was prescribed a cocktail of oral anti-arrhythmic medications, steroids, and MTx, and instructed to get symptom-based ECGs since they revealed recurrent NSVT/VT events despite OMT. The patient bought a 12-lead smartphone ECG device after a few ECG follow-ups. In August, the patient produced the initial report (Figure 1) that revealed Ventricular Tachycardia as a result of Wide QRS on the graph.

Figure 1. Patient generated first report using Smartphone ECG on 12th August 2022

Then, a report that was indicative of LBBB appeared in November, and a report that often experienced Premature Ventricular Contractions (VPCs) appeared the next week (Figure 2).

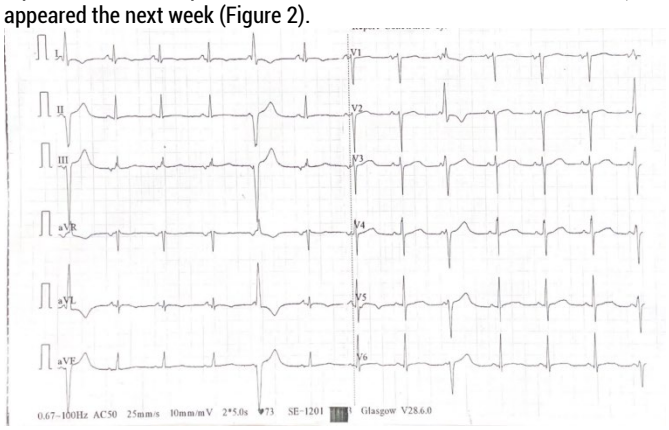

Figure 2. Gold Standard ECG on 4th July 2022 suggestive of Premature Ventricular Contraction

This smartphone-based ECG interpretation matched the Gold Standard ECG performed on July 4th, 2022 (Figure 3).

Figure 3. Report by 12 lead smartphone devices suggestive of Premature Ventricular Contraction – 20th November 2022

The patient had an Automatic Implantable Cardioverter-Defibrillator (AICD) placed after the device consistently recognised bouts of ventricular tachycardia despite optimal medical care (Figure 4). Thus, it can be shown that the smartphone ECG equipment aided the doctor's decision-making in terms of a general reduction in triage time.

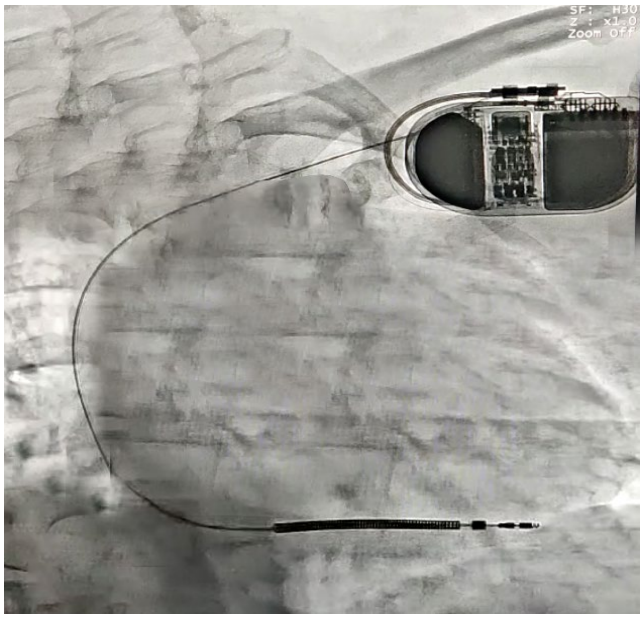

Figure 4. The Implanted Defibrillator

The ECG performed on February 26th (Figure 5), in the clinic was suggestive of Wide QRS determining of VT (LBBB Type), with outcomes comparable to the Smartphone-based ECG report prepared in August that depicted the monomorphic pattern on the graph. After the AICD was implanted, the patient underwent routine follow-up using a 12-lead smartphone-based ECG. The device's sample report for follow-up reveals a normal ECG rhythm on March 22, 2023 in (Figure 6).

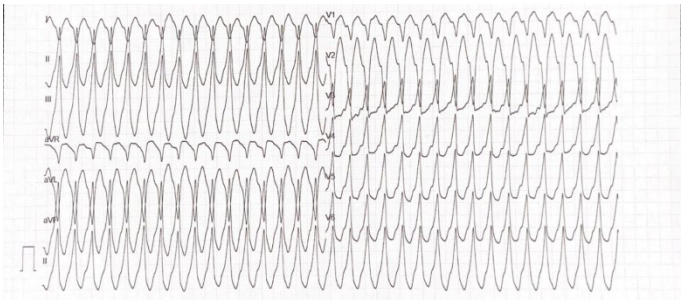

Figure 5. Gold Standard Report generated on 26th February 2023

Figure 6. Normal ECG on 12 Lead Smartphone Device after Implantation (22-Mar-2023)

Discussion

- Despite the fact that Cardiologist Interpretation is required for procedures like AICD Implantation, it is appropriately recognised that the goal of the Case Study was fulfilled when the 12 Lead Smartphone ECG gadgets helped;
- From the initial examination in May 2022 until the implantation in March 2023, and even beyond, disease management and progression for over ten months.
- The first POC instrument outside of a hospital used for normal clinical treatment because it makes ECG testing at the hospital less uncomfortable, especially for at-risk patients, and because it gives interpretation within 10 seconds at arm's length.
- Early detection reduced triage time because the patient was kept out of any emergency situations despite the disorder's severity and sensitivity. Helped with regular interpretation to identify the patient's problem pattern and come to a conclusion on the surgery almost a year before it was scheduled.
- By using interpretations that were identical to the Gold Standard 12 Lead ECG and the Cardiologist's Interpretation, the 12 Lead Smartphone ECG gadgets was validated [16].
- Aiding the decision-making of the clinicians.

Even with the availability of detection methods like Trans-Thoracic Echocardiography (TTE), which has led to event-free survival in patients with LV Dysfunction, it has insufficient specificity for Cardiac Sarcoidosis [17]. There are several diagnostic problems with sarcoidosis that make it difficult for patients to get the disease diagnosed. Preliminary diagnosis are greatly aided by the 12-Lead Smartphone ECG equipment, which may then be further clarified when the patient sees a cardiologist, as was the case in the example above.

This is the first case study of its kind that, to our knowledge, shows how the point of care device has facilitated ECG access and aided in the creation and enrolment of services that include monitoring, alerts, and two-way communication. The report from August 12, 2022, which produced a lead with a wide QRS graph, was comparable to the ECG from February 26, 2023, at another specialty hospital, which was the basis for the Cardiologists' final judgement regarding implantation (Figure 5).

Conclusion

The 12 Lead ECG gadget proved effective and useful in cutting down on the amount of time needed for triage and overall therapy in terms of illness management and progression. The Lead device is suitable to be referred to as an important First Point of Care device outside the hospital given the identical assessment of rhythm traces. As a result, a tool that aids doctors in making decisions as supporting evidence while formulating a treatment plan for a serious and uncommon case like VT-induced sarcoidosis is needed.

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