

How to Cite:

Kampally, M., Ranjith, R., & Agarwal, S. (2022). Screening of arrhythmia in early adulthood with portable 2 lead: Vigo smart heart solution. *International Journal of Health Sciences*, 6(S2), 11066–11074. <https://doi.org/10.53730/ijhs.v6nS2.7969>

Screening of arrhythmia in early adulthood with portable 2 lead: Vigo smart heart solution

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Abstract---The heart rhythm abnormality arrhythmia is commonly seen in older populations. However, arrhythmia under age 30 years is also seen in recent times. The reason for the incidence of arrhythmias is varied among the individuals based on the lifestyle changes, quality of life and genetic hereditary etc. Arrhythmia is less studied clinical condition compared to other CAD abnormalities. The detection of arrhythmia has become crucial due to its importance in management of cardiac abnormalities. The holter monitoring is the gold standard method for the detection of arrhythmia through Electrocardiogram (ECG) technique. However, the instrument is not user friendly with multiple wire tangles which results in much noise and less analysable data. The technology needs to be simplified for better screening and to take necessary actionable insights. Vigocare SmartHeart is the new generation portable, two lead biosensor solution by which advanced AV block and White Parkinson's Syndrome was identified in the patients aged less than 30 years old. The Vigo SmartHeart biosensor solution is functioning with the combination of mobile technology. IoT based cloud for storage and AI for analysis serves utmost sensitivity for the clinical interventions.

Keywords---arrhythmia, IoT, artificial intelligence, biosensor, vigocare smartheart, young population, ECG.

Introduction

Importance of Technology

The advanced technologies such as Internet of Things (IoT) and cloud-based platforms with Artificial Intelligence (AI) are paving a new pathway for the quick and reliable advanced diagnostic services. However, the application and implementation of the technology needs to be evaluated properly for full scale utility and scalability.

Any alterations in the heart conduction pathway causes irregular heartbeat. This disorder occurs when the electrical impulses that coordinate the heart conduction do not travel in normal pathway. The faulty signalling causes the heart to beat too fast i.e., tachycardia, too slow i.e., bradycardia (1) (3). In the conditions of tachycardia or bradycardia, the heart may not be able to pump enough blood to the body. Although most of the arrhythmias are non-serious, but some arrhythmias can be serious or even life threatening. Which can be associated with serious symptoms that can alter the vital functions(2)(3). Lack of blood flow can damage the brain, heart, and other organs. If irregular heartbeats are frequent or long lasting, they can be grievous.

According to the World Health Organization (WHO), in the leading 10 causes of death, the heart related abnormalities such as ischemic heart disease, stroke and cardiovascular diseases (CVD) are major contributing disorders worldwide (4). The studies reveal that annually approximately 17.9 million mortalities are occurring with a leading cause of CVD and its associated disorders. The heart rhythm abnormality is one of major causes contributing to the rise in death rate and is less studied clinical parameter in Indian patients. Most of the arrhythmias are age-related arrhythmias. The prevalence of Arrhythmia increases by 16.1% in above 80 years aged population(5). However, due to lifestyle changes, the incidence of arrhythmia is also being detected in early adulthood below 30 years population (6).

Low-income countries like India and South Asian countries are less studied for the prevalence of arrhythmia.(7) The limiting factor can be the compromised infrastructure, availability of the technology and affordability. The typical physical examination may not reveal the hidden abnormality all the time. Short-term ECG may fail to hit the accurate abnormality since some arrhythmia occurs in episodes(8). However, the long-term continuous monitoring technology would be beneficial to overcome this hindrance and useful for timely detection and diagnosis. The telehealth mobile technology, which would use the IoT and Artificial intelligence, has been proving to be a promising technology to use for diagnosis arrhythmia in Indian healthcare settings (9–11).

Arrhythmia is commonly seen in older patients, but recent studies are proved that the early adulthood and adult population is also having the incidence of arrhythmia. It could be due to the changes in biological, social, and environmental changes etc. the screening and detection of arrhythmia needs to be simplified by using technological advancements in working group populations. The traditional holter technique has limitations of more noise and discomfort. Any

technology which would help in overcome this hindrance would be a great help in diagnosis of arrhythmia.

Materials and Methods

The Vigo SmartHeart is a IoT based platform that is integrated with artificial intelligence program for analysis of abnormalities in the heart conduction cycle. The usage of cloud has simplified the storage and maintenance requirements of health data in analysable form. The data usage and generated reports are maintained with privacy and as per the local regulatory norms. This high-end technology is simplified into few simple steps as follows

Onboarding: The onboarding of Vigo SmartHeart has several simple steps, which are downloading the mobile application from the google play store, App store and integration of the solution with mobile application by entering the unique code that is printed on the solution patch. The integration between the patch and mobile application is established by mobile hotspot technology.

Central Monitoring Station (CMS) and Monitoring: Upon the onboarding of a patient, the heart rate vital data started flowing in the mobile application and dedicated central monitoring station in real time simultaneously.



Fig1: Representation of central monitoring station

Storage: The acquired data from the monitoring is continuously uploaded to the cloud and stored readily for the analysis.

Analysis and report generation: the data is pushed to artificial intelligence (AI) platform for analysis. The deep neural network methodology is used to find the abnormality of the arrhythmia conditions.

Delivery of report: The report is delivered to the registered patient and doctors E-mail within half an hour of post monitoring period.

E-Dairy: The event E-dairy is an exclusive option in the mobile application by which the patient can register the events on the exact timing of symptoms occurs during the monitoring period.

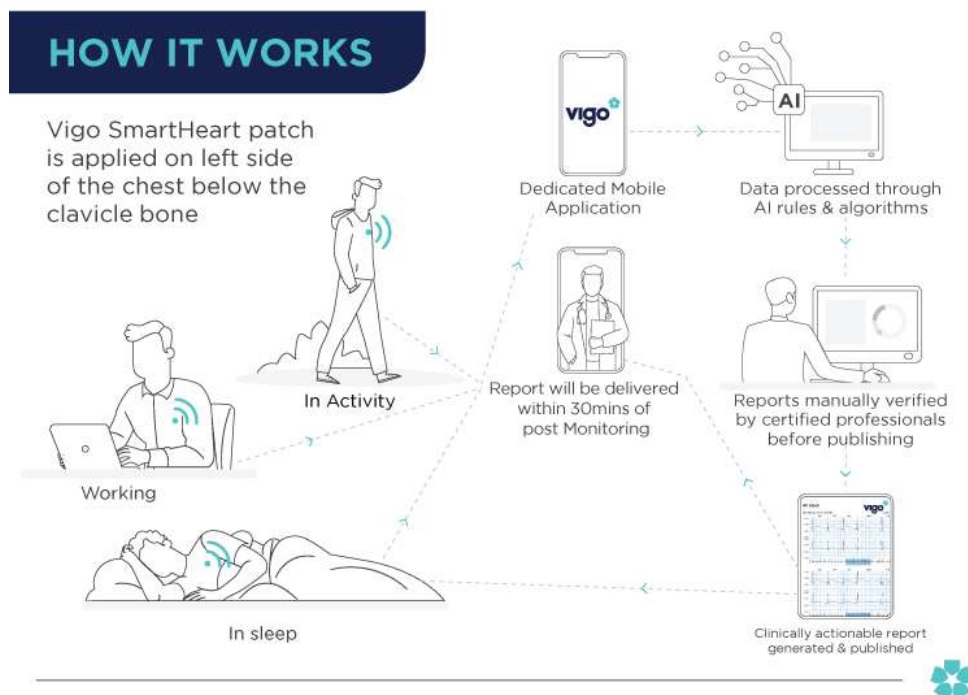


Fig 2: Schematic representation of Vigo SmartHeart working pipeline.

With the described technology many cases were studied successfully, However only two cases were presented below for our study as per the objectives.

Case 1. A 27-year patient was admitted to the emergency department with chief complaints of syncope, shortness of breath, and nausea preceded by headache. The patient had a previous surgical history of double valve replacement (Mitral and Aortic valve). The vitals measurements observed at the time of admission as blood pressure (BP) -100/82 mmHg, heart rate 48 beats per minute (BPM), and respiratory rate (RR) of 19 beats per minute respectively. The short ECG result showed it was sinus bradycardia. The laboratory investigations were within the normal range. The case was referred to the cardiology department for the management of bradycardia. The monitoring was initiated with Vigo SmartHeart 5 days long-term continuous monitoring.

Case2. A 28year female patient visited outpatient with complaints of palpitations and giddiness. The patient had a positive history of anxiety, chest pain, and episodes of fainting. The patient was monitored by Vigo SmartHeart 5-days long term ECG monitoring.

Results and Discussions

Case 1. The Vigo SmartHeart 5 days long term continuous monitoring detected an advanced AV block in 27 years old patient.

Case2. The Vigo SmartHeart 5-days long term ECG monitoring report demonstrated HR of 133 and the occurrence of short PR intervals (<120ms) with prolonged QRS complex (>110ms) with excitation of delta waves. The report suggested that the presence of Wolf-Parkinson-White syndrome in 28 years old patient.

Clinical background of Advanced AV Block, identification, and analysis by VSH

In a high-grade AV block, the electrical signal from the atria to the ventricles is completely blocked.(12) To make up for this, the ventricle usually starts to beat on its own as a substitute pacemaker but the heartbeat is slower, often irregular, and not reliable. This condition seriously affects the heart's ability to pump blood out to the heart.



Fig 3: ECG-Strip Clinical presentation of advanced AV-Block (5:1 ratio of P: QRS)

The Morphological changes of ECG-Analysis for advanced AV-Block

In the ECG, Ventricular rate was regular and atrial rate was irregular, Ventricular rate was 60 BPM and atrial rate was 100 BPM. The QRS Complex duration was normal (0.08Sec) within normal morphology and there was a progressive prolongation of PR Interval that suggests the patient might also have second degree AV block Type I. The P wave: QRS Ratio 5:1 Suggests it was an Advanced AV Block. The advanced AV block might be progressed from the second-degree AV-Block type-1.

Treatment: Based on the above findings in the ECG, the patient was treated with a permanent pacemaker and discharged in a stable condition with BP of 120/80 mmHg, Temperature 98 °F, SpO₂ 96 % and RR 20 per minute respectively. The ECG of the patient after the treatment was represented in Fig 4.

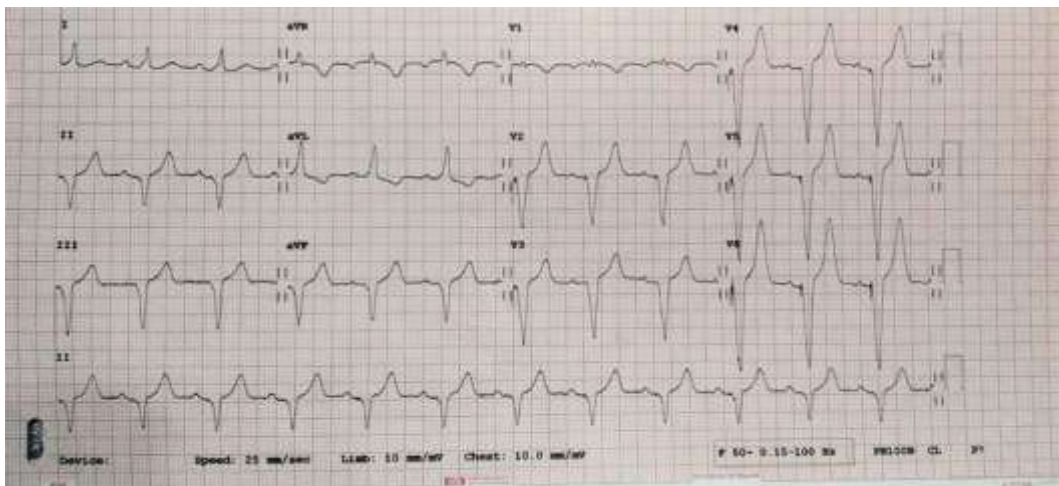


Fig 4: Post treatment ECG –Representation

Clinical background of WPW –Syndrome

Evaluation of the patient with Wolff-Parkinson-White (WPW) syndrome with tachyarrhythmia is often difficult, since, episodes of tachyarrhythmia most often subside spontaneously before the medical observation is obtained.(13)

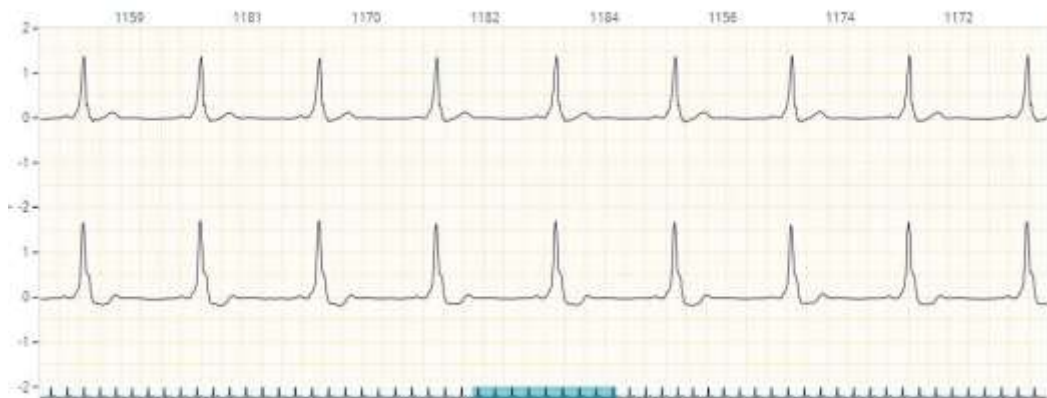


Fig 5: the Schematic representation of ECG- with WPW- Syndrome

Treatments: In Case2: the patient was diagnosed with Wolf-Parkinson's-White syndrome and the patient was kept under treatment with propranolol hydrochloride therapy. The follow-up ECG monitoring confirmed the clinical improvement. The patient had a family history of sudden cardiac death and the WPW syndrome was an accidental finding with Vigo Smart Heart monitoring.



Fig 6: The ECG representation after treatment

Discussion

India and south Asian countries are mostly developing nations, where the healthcare infrastructure has not been advanced to as to the extent to screen and maintain the medical records of everyone. The public health care sector needs to be developed to a grassroots level to design and implement a health care policy. However, these countries are densely populated, and affordability is a major concern for the governments and to the individuals. In India, the healthcare is mostly an individual responsibility and it has become a burden to individuals and families since there was no concrete national wide healthcare insurance policy by the government. There is subside healthcare insurance infrastructure across the country. In the light of COVID-19 pandemic there is an unrest in healthcare sector and facing a turbulence in managing the patient's burden. To overcome these hurdles the technology solutions such as remote patient monitoring, telehealth and point of care diagnostics are striving to prove the accuracy in the diagnosis and treatments processes(14–18). The recent studies shows that the early adulthood and adult population is also prone to rhythm abnormalities due to lifestyle changes(7).

The Vigocare 2-Lead SmartHeart biosensor is next generation solution in finding the arrhythmia in active settings. The patients need not to be restricted from the daily routines. The heart rate vital would be captured on the go and the same will be analysed at the end of the monitoring period. The report will be delivered to the smartphone within 30 minutes post monitoring period. The SmartHeart 2-Lead continuous monitoring solution for arrhythmia detection would be an ideal solution to screen adult workforce without disturbing their routines.

Conclusions

The portable biosensor long-term ECG monitoring solution with AI engine was successfully used for analysis and accurate detection of advanced AV-block and wolf-Parkinson's White syndrome. The described two cases were below 30 years, and this study provides with inputs on the prevalence of arrhythmia in early adulthood populations. Therefore, there is a need of screening for rhythm

disorders in the early adults. The high-grade technological solution, Vigo SmartHeart, was demonstrated its efficiency in identifying the reported arrhythmias on the go successfully. However, to a large scale, well-designed clinical study might be required to establish the clinical accuracy and to infer the statistical significance for the technology discussed.

Author Contributions: Every author contributed equally to designing, execution of the study and manuscript preparation.

Funding: No fundings received

Institutional Review Board Statement: The study did not require ethical committee approval

Informed Consent Statement:

“Written informed consent has been obtained from the patient(s) to publish this paper”.

Data Availability Statement: “Not applicable”

Acknowledgments: We acknowledge Dr. Mehdi Ali Mirza ESIC-Hyderabad, India, for the support in manuscript preparation.

Conflicts of Interest: “The authors declare no conflict of interest.”

References

1. Patel N, Donahue C, Shenoy A, Patel A, El-Sherif N. Obstructive sleep apnea and arrhythmia: A systemic review. *Int J Cardiol.* 2017 Feb 1;228:967–70.
2. Hannun AY, Rajpurkar P, Haghpanahi M, Tison GH, Bourn C, Turakhia MP, et al. Cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network. *Nat Med.* 2019 Jan 1;25(1):65–9.
3. Fallet S, Yazdani S, Vesin JM. False arrhythmia alarms reduction in the intensive care unit: A multimodal approach. *Physiol Meas.* 2016;37(8):1217–32.
4. Kaptoge S, Pennells L, De Bacquer D, Cooney MT, Kavousi M, Stevens G, et al. World Health Organization cardiovascular disease risk charts: revised models to estimate risk in 21 global regions. *Lancet Glob Heal.* 2019;7(10):e1332–45.
5. De Simone V, Mugnolo A, Zanotto G, Morando G. Direct oral anticoagulants for patients aged over 80 years in nonvalvular atrial fibrillation: The impact of frailty. *J Cardiovasc Med.* 2020;21(8):562–9.
6. Marshall, Stevenson-Hinde. Behavioral Inhibition, HeartPeriod, and Respiratory SinusArrhythmia in Young Children.
7. Kodani E, Atarashi H. Prevalence of atrial fibrillation in Asia and the world. *J Arrhythmia* [Internet]. 2012;28(6):330–7. Available from: <http://dx.doi.org/10.1016/j.joa.2012.07.001>
8. Andreotti F, Carr O, Pimentel MAF, Mahdi A, De Vos M. Comparing Feature-Based Classifiers and Convolutional Neural Networks to Detect Arrhythmia from Short Segments of ECG.
9. Kashou AH, Mulpuru SK, Deshmukh AJ, Ko W-Y, Attia ZI, Carter RE, et al. An artificial intelligence-enabled ECG algorithm for comprehensive ECG interpretation: Can it pass the ‘Turing test’? *Cardiovasc Digit Heal J* [Internet]. 2021;2(3):164–70. Available from: <https://doi.org/10.1016/j.cvdhj.2021.04.002>

10. Christopoulos G, Graff-Radford J, Lopez CL, Yao X, Attia ZI, Rabinstein AA, et al. Artificial Intelligence-Electrocardiography to Predict Incident Atrial Fibrillation: A Population-Based Study. *Circ Arrhythmia Electrophysiol.* 2020;(December):1420–7.
11. Nagarajan VD, Lee S-L, Robertus J-L, Nienaber CA, Trayanova NA, Ernst S. Artificial intelligence in the diagnosis and management of arrhythmias. *Eur Heart J.* 2021;1–13.
12. Barold SS, Sischy D, Punzi J, Kaplan EL, Chessin L. Advanced atrioventricular block in a 39-year-old man with acute rheumatic fever. *PACE - Pacing Clin Electrophysiol.* 1998;21(11 I):2025–8.
13. Luthra A. WPW Syndrome. 50 Cases *Clin Cardiol.* 2014;189–189.
14. Kampally DMR, Mirza DMA, Agarwal DS. A Retrospective Study on “Effectiveness of Remote Patient Monitoring in Covid-19 patients”. *YMER Digit.* 2022;21(01):136–43.
15. Gopinath N. Artificial intelligence: Potential tool to subside SARS-CoV-2 pandemic. *Process Biochem.* 2021 Nov 1;110:94–9.
16. Tabacof L, Wood J, Mohammadi N, Link KE, Tosto-Mancuso J, Dewil S, et al. Remote Patient Monitoring Identifies the Need for Triage in Patients with Acute COVID-19 Infection. *Telemed e-Health.* 2021;00(00):1–6.
17. Muller AE, Berg RC, Jardim PSJ, Johansen TB, Ormstad SS. Can Remote Patient Monitoring Be the New Standard in Primary Care of Chronic Diseases, Post-COVID-19? *Telemed e-Health.* 2021;00(00):1–28.
18. Vindrola-Padros C, Sidhu MS, Georghiou T, Sherlaw-Johnson C, Singh KE, Tomini SM, et al. The implementation of remote home monitoring models during the COVID-19 pandemic in England. *EClinicalMedicine.* 2021 Apr 1;34.