Wearables In Heart rhythm Disorders

Sampath Gunda, MD, MHA
Assistant Professor - Clinical
Department of Internal Medicine
Division of Cardiovascular Medicine
The Ohio State University Wexner Medical Center

MedNet21
Center for Continuing Medical Education

The Ohio State University
Wexner Medical Center

Objectives

- Case Study
- Indications for wearables
- Technology and Efficacy
- Types of Wearable
- Comparison of different wearables
- Pertinent features of each modality

A Case Study

35 yr. old Male without past medical history with episodes of Syncope. One in Fall 2024. Another one is summer 2025. Preliminary work up has been negative. Which monitor should we order to diagnose th?

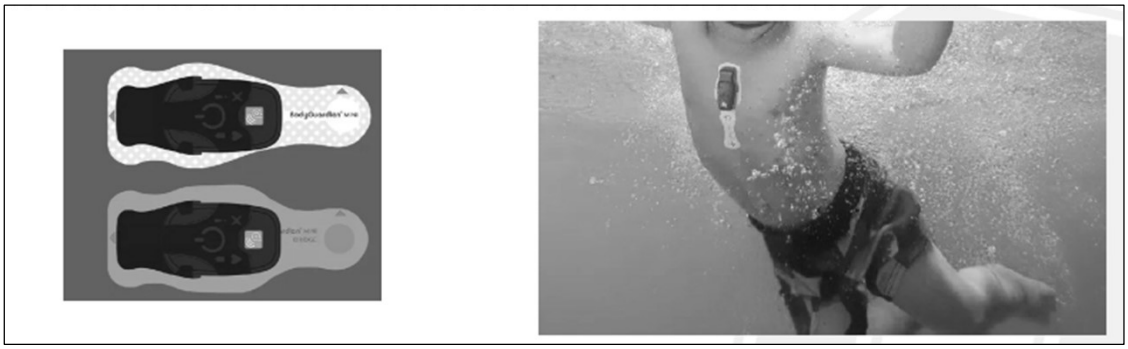
A. Implantable Loop Recorder
B. Holter Monitor
C. Long Term Mobile Cardiac Telemetry
D. Stat EKG

Heart Rhythm Wearables: Zio Monitors

Zio Patch and Zio AT

Heart Rhythm Wearables:

Boston Scientific BodyGuard Preventes Patches



Heart Rhythm Wearables

Implantable Loop Recorders

Role of Wearables

- ❖Physical activity is inversely correlated to adverse cardiovascular outcomes and all- cause mortality.
- ❖Heart rate (HR) measurements during rest and exercise can be used to predict the risk of cardiovascular disease.
- ❖High resting HR is also well recognized as a predictor of adverse outcomes in patients with heart failure (HF).

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- Healey JS, Connolly SJ, Gold MR, et al; ASSERT Investigators. Subclinical atrial fibrillation and the risk of stroke. N Engl J Med 2012;366:120–129.
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Role of Wearables

AF detection and management

- ❖ASSERT (Asymptomatic Atrial Fibrillation and Stroke Evaluation in Pacemaker Patients and the Atrial Fibrillation Reduction Atrial Pacing Trial): Subclinical atrial tachyarrhythmias had occurred in 10.1%, which increased the risk of AF by x 5.5 and stroke by x 2.5.
- ❖ARTESIA (Apixaban for Stroke Prevention in Subclinical Atrial Fibrillation) trial: Subclinical atrial fibrillation for 6 minutes to 24 hours, apixaban resulted in a lower risk of stroke or systemic embolism than aspirin.

Role of Wearables
Syncope and Ventricular Arrhythmias

- Identification of cause of syncope
- PVC: Quantification of PVC burden
- Ventricular tachycardia and Ventricular Fibrillation

Sensor Technology
Types of sensors

- Activity Sensor: Accelerometer (piezoresistive, piezoelectric and differential capacitive accelerometers)
- GPS Systems.
- Barometers.
- Heart Rate and Rhythm Sensors: ECG, Photo-phlethysomography (PPG), Artificial Intelligence.
- Seismo-cardiogram (SCG).
- Ballisto-cardiogram: (BCG).

Sensor Technology

Type of Sensor	Measurement
Accelerometer	Measures the acceleration of the limb and body
Photo-Phlethysmography	Measures the changes in the blood volume in microvascular bed
Electrocardiogram	Measures the electrical activity of the heart
Seismo-cardiogram	Measures the mechanical activity of the heart
Ballisto-cardiogram	Measures the recoil force in the body in response to the ejection of the blood.

Wearables (commercially available) efficacy

AF detection by commercially available wearables (As of Feb 2025)

Device	Technology	FDA Approval	Sensitivity	Specificity	Inconclusive tracings
Apple Watch Series 6	PPG and EKG	Yes	85%	75%	18%
Samsung Galaxy 3	PPG	Yes	85%	75%	17%
Withings ScanWatch	PPG and EKG	Yes	58%	75%	24%
FitBit Sense	PPG	Yes	66%	79%	21%
AliveCor KardiaMobile	EKG	Yes	79%	69%	26%

Manhart D et al, JACC 2023

Data behind the technology
Clinical Studies

- Fitbit Heart Study
- Apple Heart Study

Challenges with wearables (commercially available)

Challenge	Explanation
Data privacy and security	Security Breech and lack of legal restrictions
False positive and False Negative	Unnecessary health care utilization and lack of trust
Validation	Lacks rigorous clinical validation and approvals with changing new technology
Ethical consideration	Vs Business
Compatibility issues	Integration with EMR
Cost and Payment Considerations	Ever increasing cost and reimbursement issues with insurance coverage
Regulatory Changes	Lack of any regulation in quality and use of new technology.

Comparison of Holter and Loop recorders

Variable	Holters	Event Recorders /External Loop Recorders	Implantable Loop Recorders
Method	Continuous	Records the start and end of the arrhythmias	Both
Symptom Frequency	24-48 hours	Week to Month	More than a month
Convenience to Patient	Moderate	Moderate	More
Indication	PVCs/PACs, Heart Rate monitoring	Symptomatic episodes	Both
Real Time monitoring	Variable	Variable	Not possible
Diagnostic Accuracy	Variable	Variable	95-100%
Cost	Variable ($$$)	Variable ($$$)	$$$$

Holters vs Event Monitors

- Frequent Symptoms
- Battery life (varies from 2 weeks to 4 weeks)
- Continuous Monitor/Holter vs Event monitor
- Live monitoring
- Non-invasive
- Allergic to patches
- Less expensive

Implantable loop recorders

- ❖Infrequent symptoms
- ❖Long term detection: Battery life ~5 years.
- ❖Can be activated by the patient
- ❖ Records ~15 min before and after the event
- ❖Invasive procedure and require trained personnel to implant
- ❖Expensive
- ❖False positive (Sinus with PAC as Atrial Fibrillation)
- ❖False negatives (Atrial flutter as sinus tachycardia)

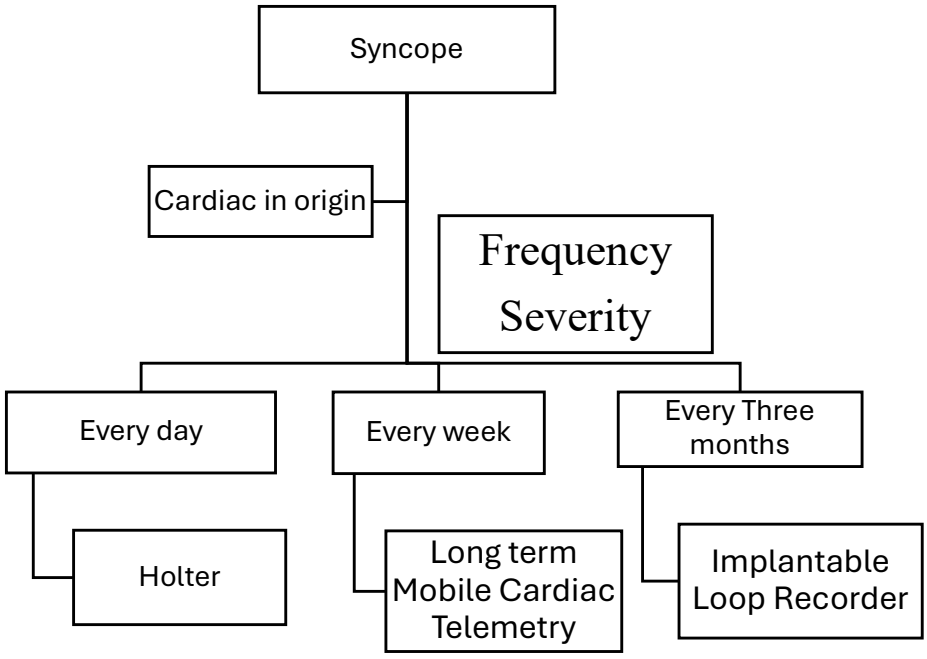
Data behind the technology
Clinical Trial

- ❖MSTOPS study
- ❖Crystal-AF study
- ❖STROKE AF study
- ❖ PICTURE Study
- ❖REVEAL AF study

Miscellaneous Features to consider

- Mailed vs in clinic placement
- Allergies
- Single lead vs Multiple leads
- Waterproof or not
- Continuous Monitoring vs Event Triggers
- Data Storage
- Data Transmission
- Data Management

Evaluation of Syncope



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Question: 35 yr. old Male without past medical history with episodes of Syncope. One in Fall 2024. Another one is summer 2025. Preliminary work up has been negative. Which monitor should we order to diagnose the cause of syncope?

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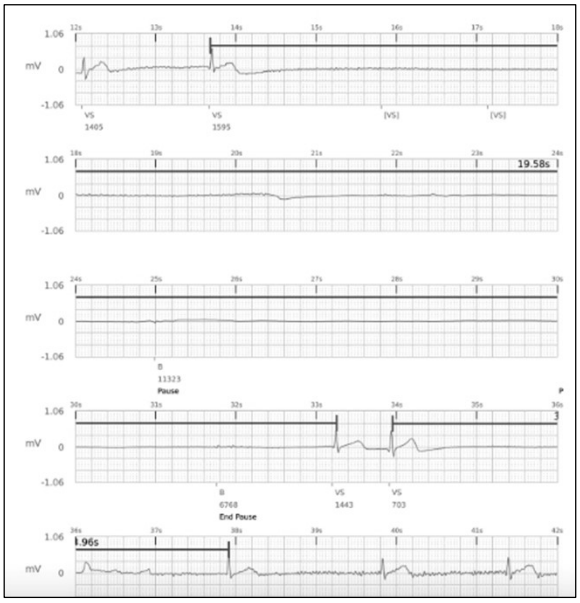
ILR was implanted and showed

Sinus arrest of 19 sec.



Summary

- ❖Choice of Wearable depends on the frequency of symptoms
- ❖Use the most effective and minimally invasive modality to diagnose
- ❖Patient Education is very important
- ❖Mindful of nuances in technology, false positives and false negatives
- ❖ Expert Consultation in advanced and complex rhythm disorers