Wearable Cardioverter Defibrillator

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History

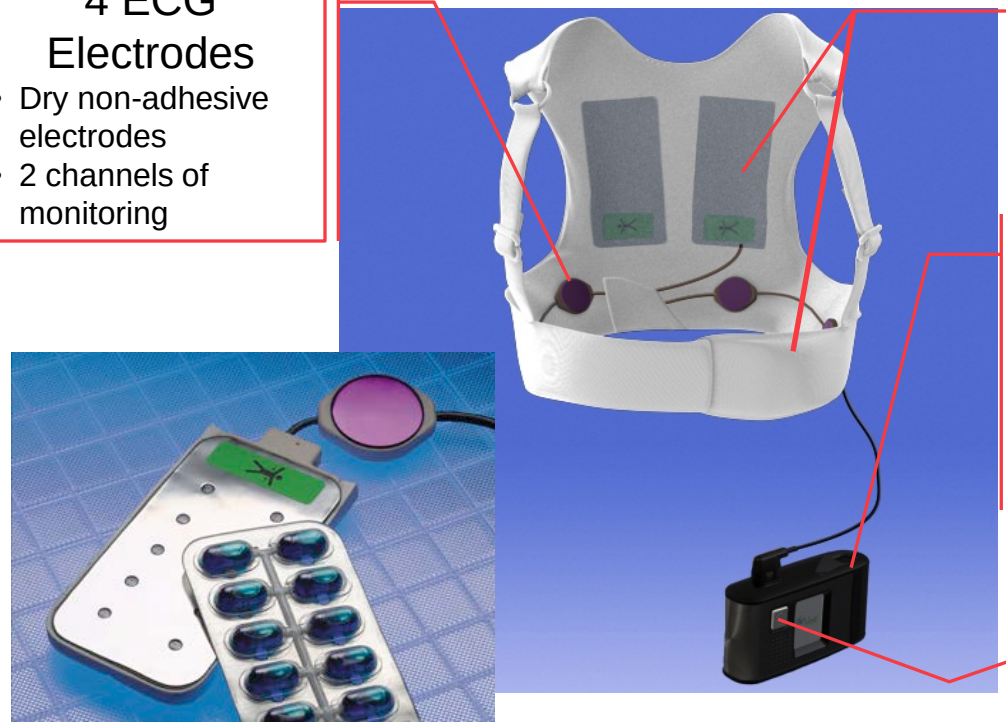
First defibrillation	1947	Claude Beck
First closed chest defibrillation	1956	Paul Zoll
First ICD implant	1980	Michel Mirowski

Wearable ICD developed in late 1980's by Stephen Heilman and Lifecor, FDA approved 2001

LifeVest

WCD Description: LifeVest System

4 ECG Electrodes
- Dry non-adhesive electrodes
- 2 channels of monitoring



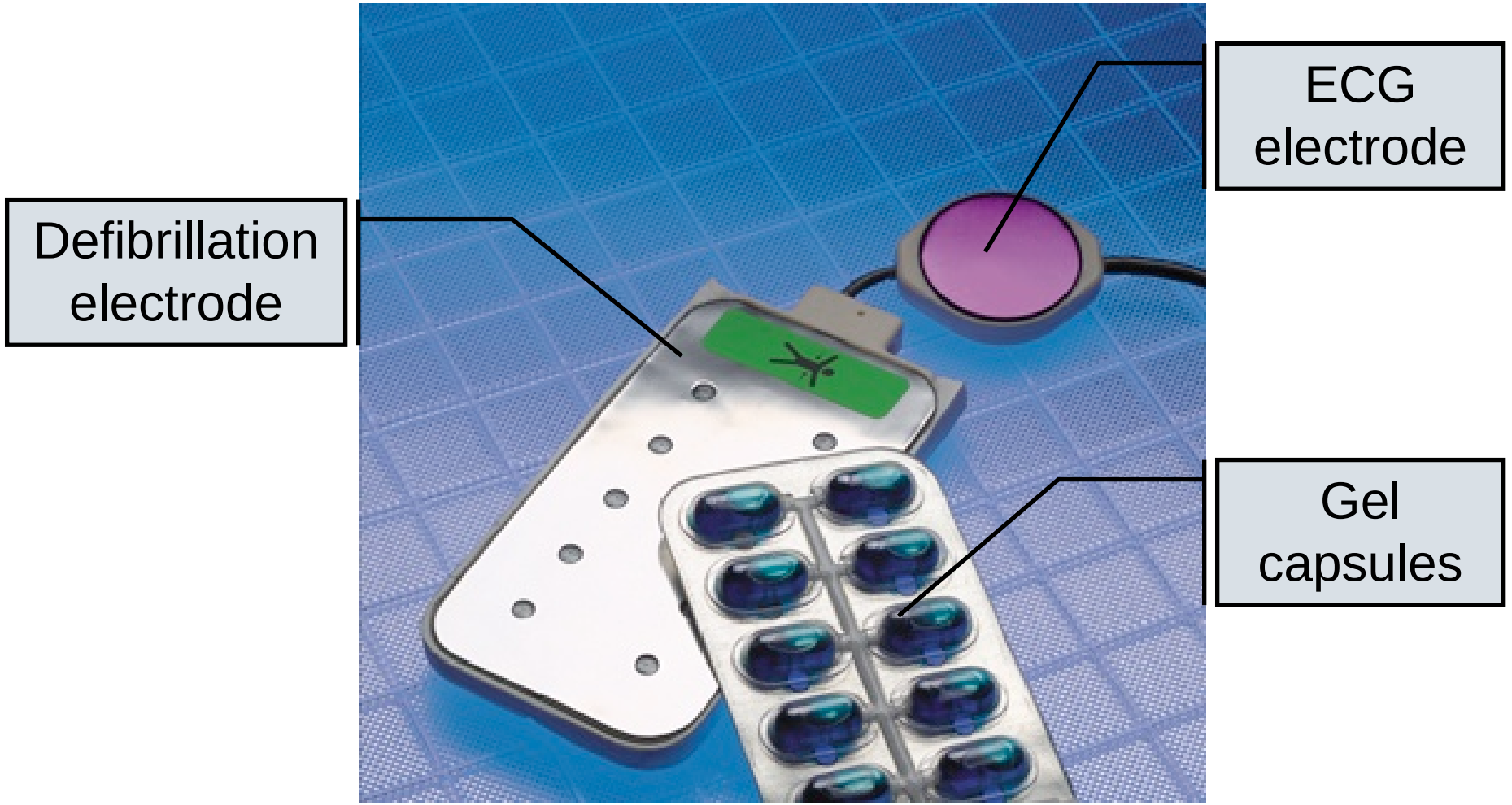
Self-Gelling Defibrillation Electrodes

Monitor
- 150 J biphasic
- Stores ECG 30s before events, 75 min capacity
- Records events and daily use

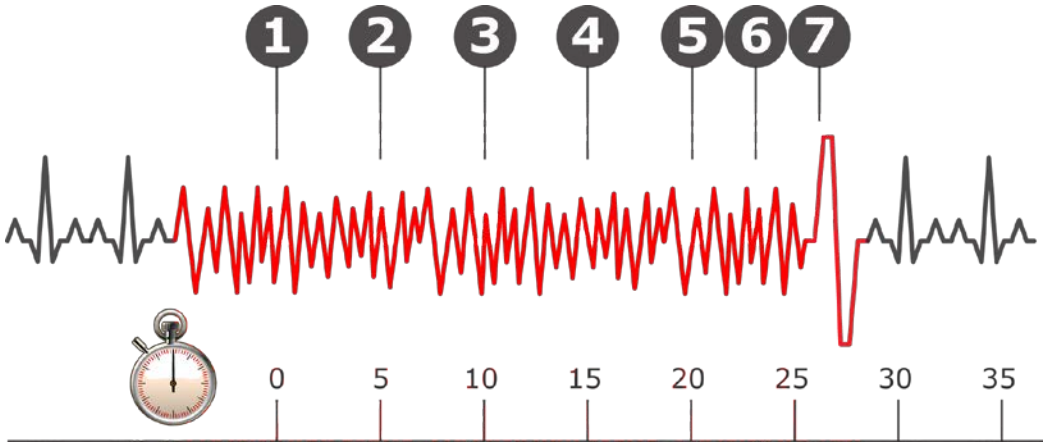
Response Buttons
Inhibit shock if awake (test of consciousness)

No current pacing capabilities

WCD Electrodes



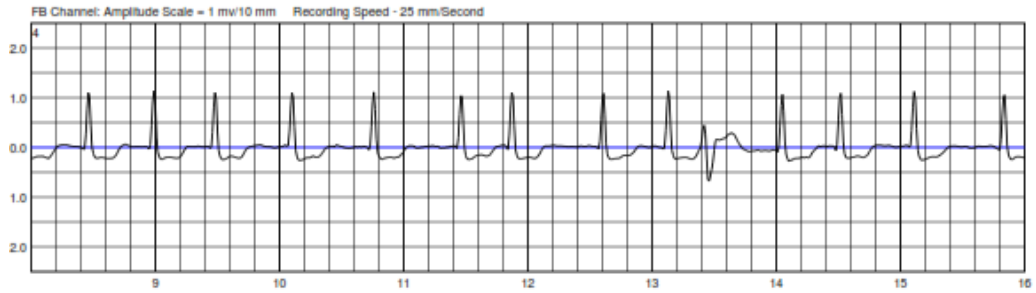
WCD System Treatment Sequence



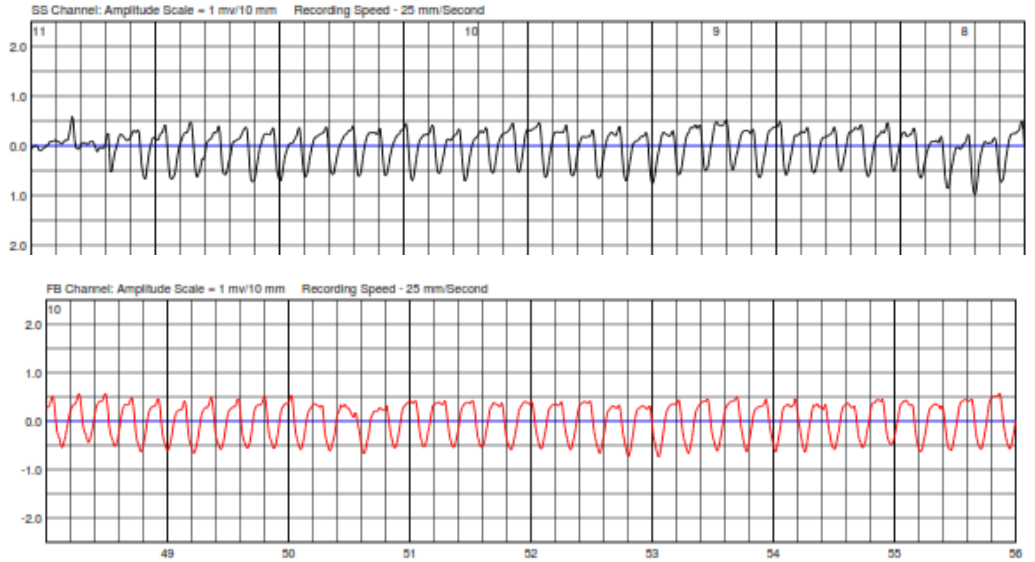
1. **Arrhythmia detected, activating vibration alert (continues throughout sequence).**
2. **Siren alerts begin (continues throughout sequence).**
3. **Siren alerts get louder.**
4. **Patient audible prompt: “Electrical shock possible.”**
5. **Gel release.**
6. **Bystander audible prompt: "Do not touch patient.”**
7. **Treatment shock.**

67 y/o man with recent acute MI, EF 20%, Afib, s/p CABG discharged with WCD. Day 4 after discharge, at rehab.

Baseline A Fib

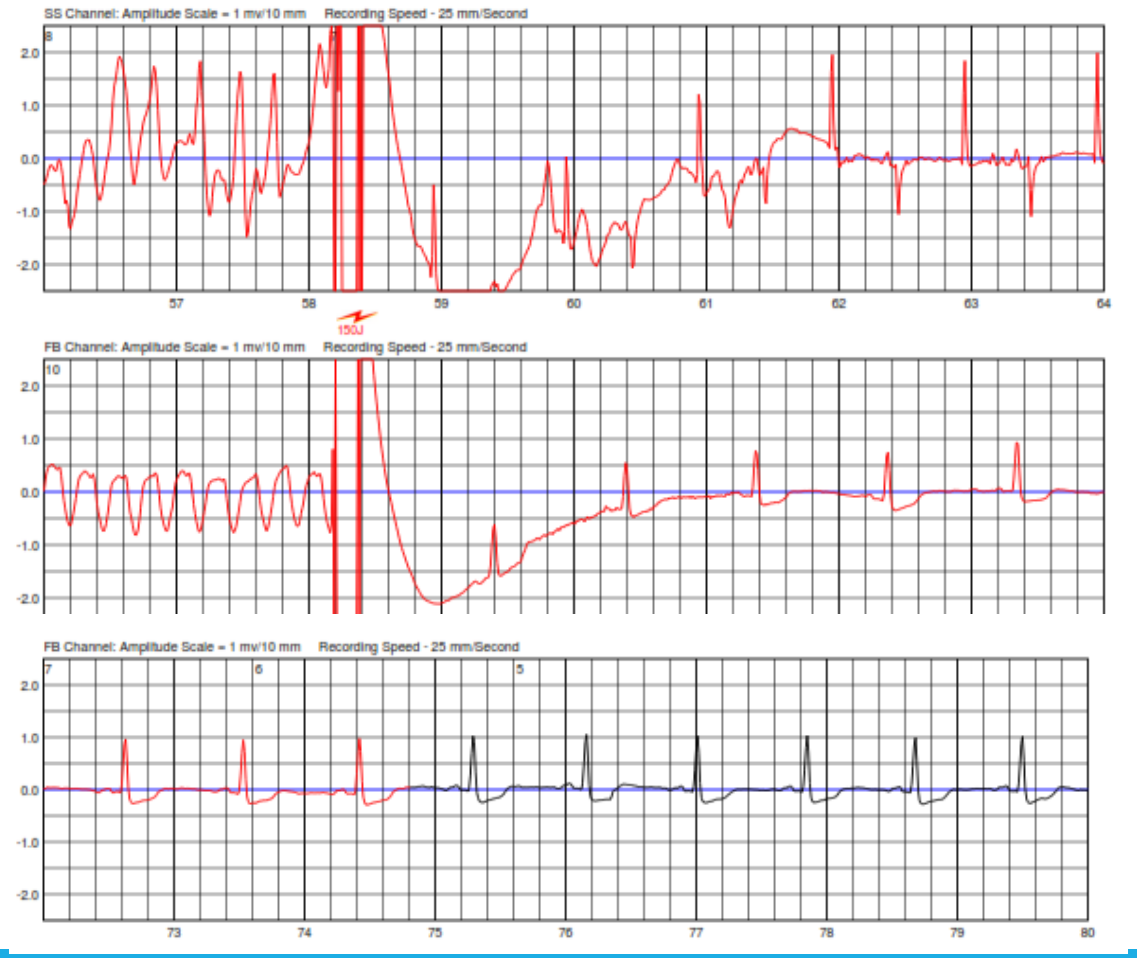


VT



VT detected and shock delivered after 69 seconds

Shock Delivered

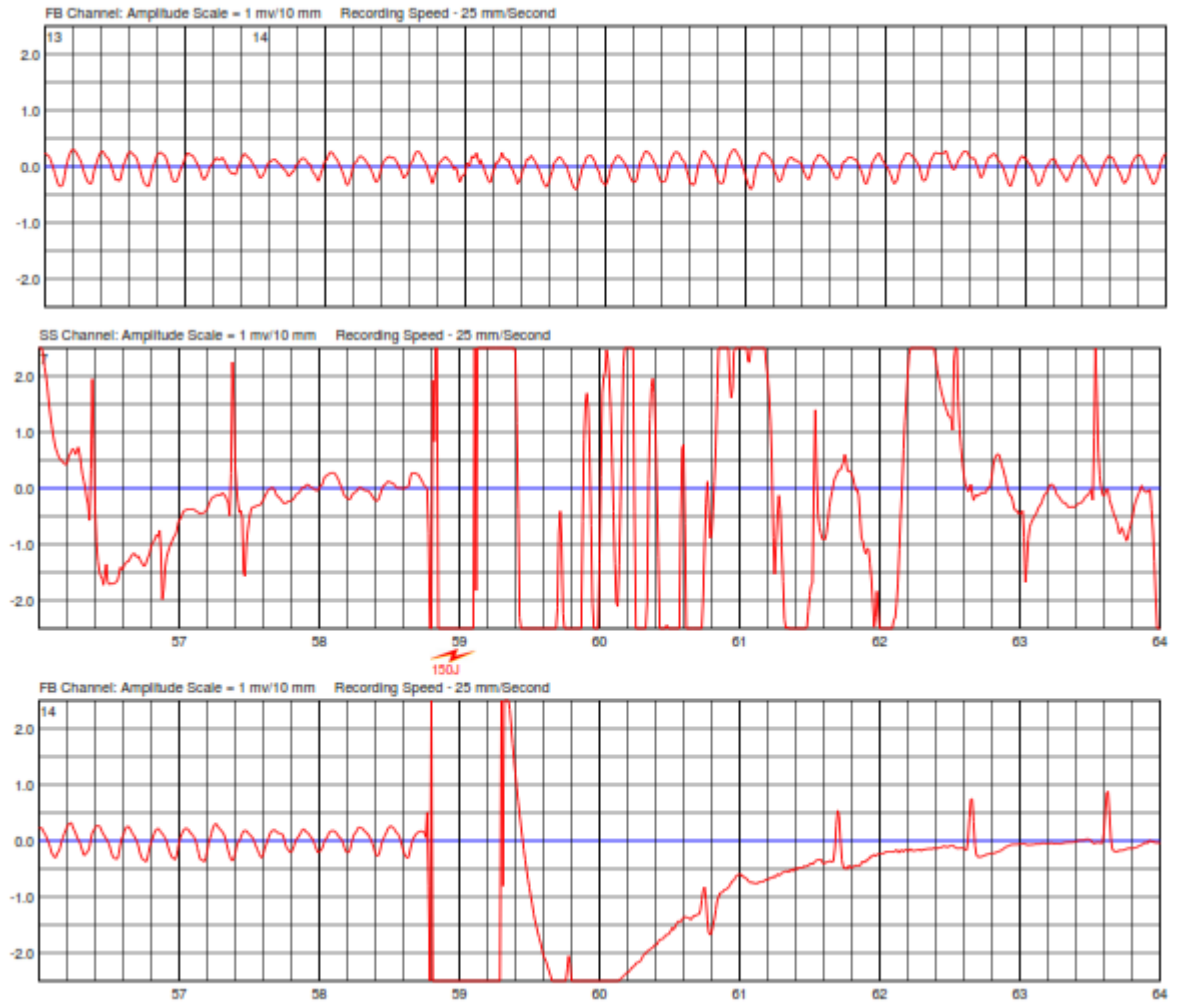


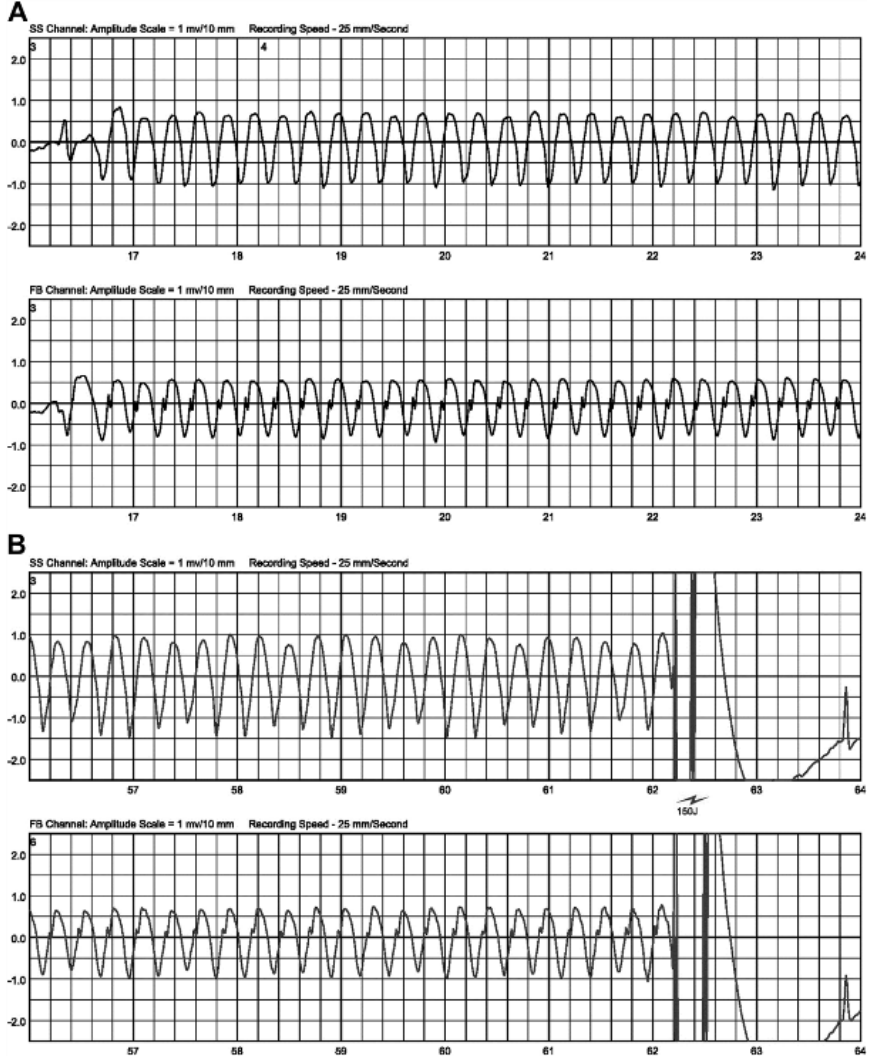
Sinus Rhythm

Second Event, 25 Minutes Later

VF

150J shock, return to sinus rhythm



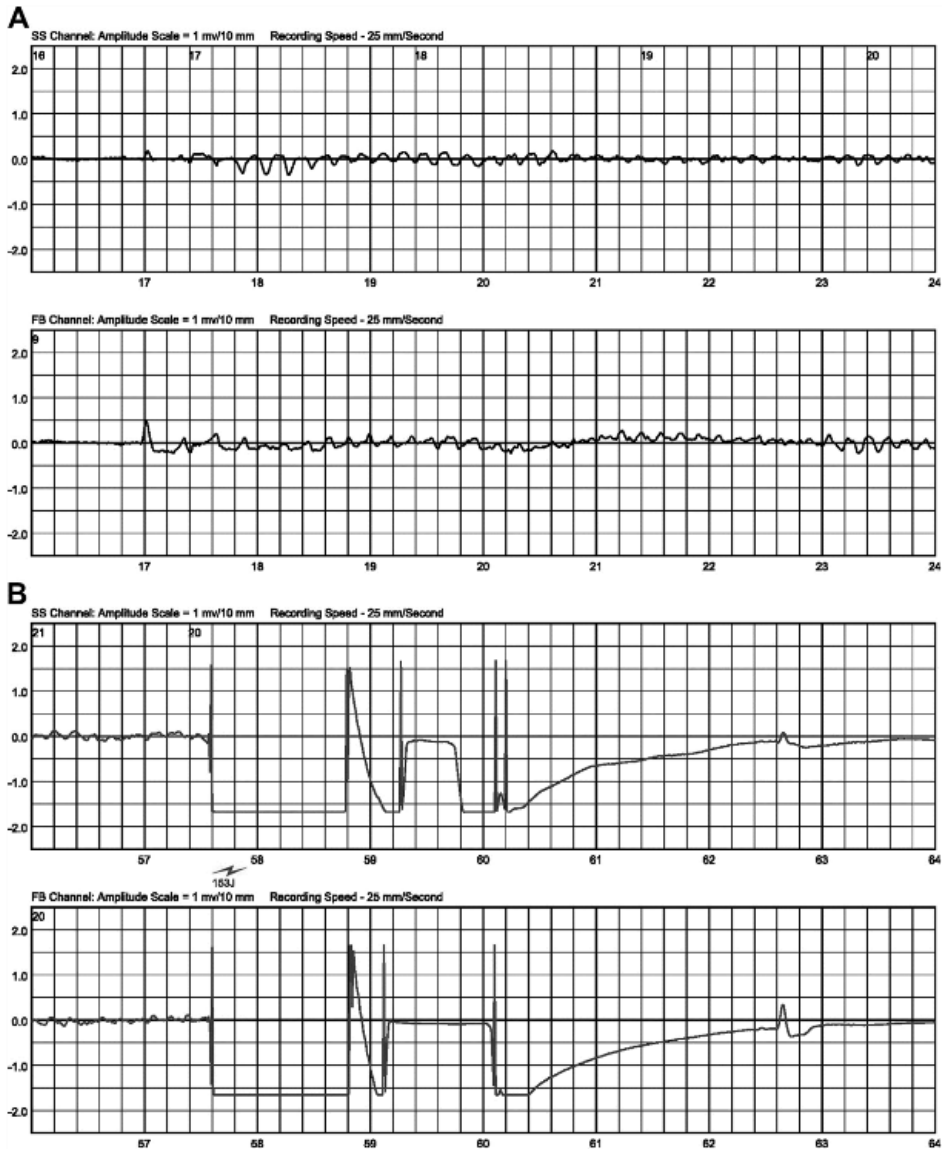


WCD Recording of Cardiac Arrest Due to MVT

Recordings from resuscitation of cardiac arrest from monomorphic ventricular tachycardia (MVT) showing arrhythmia onset (A) and cardioversion 45 s later (B). WCD = wearable cardioverter-defibrillator.

From: Wearable Cardioverter-Defibrillator Use in Patients Perceived to Be at High Risk Early Post-Myocardial Infarction

J Am Coll Cardiol. 2013;62(21):2000-2007. doi:10.1016/j.jacc.2013.05.086



WCD Recording of Cardiac Arrest Due to VF

Recordings from resuscitation of cardiac arrest from ventricular fibrillation (VF) showing arrhythmia onset (A) and defibrillation 41 s later (B).

From: Wearable Cardioverter-Defibrillator Use in Patients Perceived to Be at High Risk Early Post-Myocardial Infarction

J Am Coll Cardiol. 2013;62(21):2000-2007. doi:10.1016/j.jacc.2013.05.086

Efficacy – Results from WEARIT/BIROAD study

289 patients

3.1 months of use

6 successful defibrillations

2 unsuccessful due to reversal of vest and defib electrodes

6 unnecessary shocks

Feldman, et al. PACE 2004;27:4-9

Efficacy of WCD

Chung, et al. Aggregate National Experience with the Wearable Cardioverter-Defibrillator

- 3,569 patients
- 80 VT/VF events in 59 patients (1.7%)
- First shock success 79/80. One failure to convert.
- 76 pts were unconscious at the time of shock.
- 2 shocks resulted in asystole >15 sec but both survived

J Am Coll Cardiol 2010;56:194-203

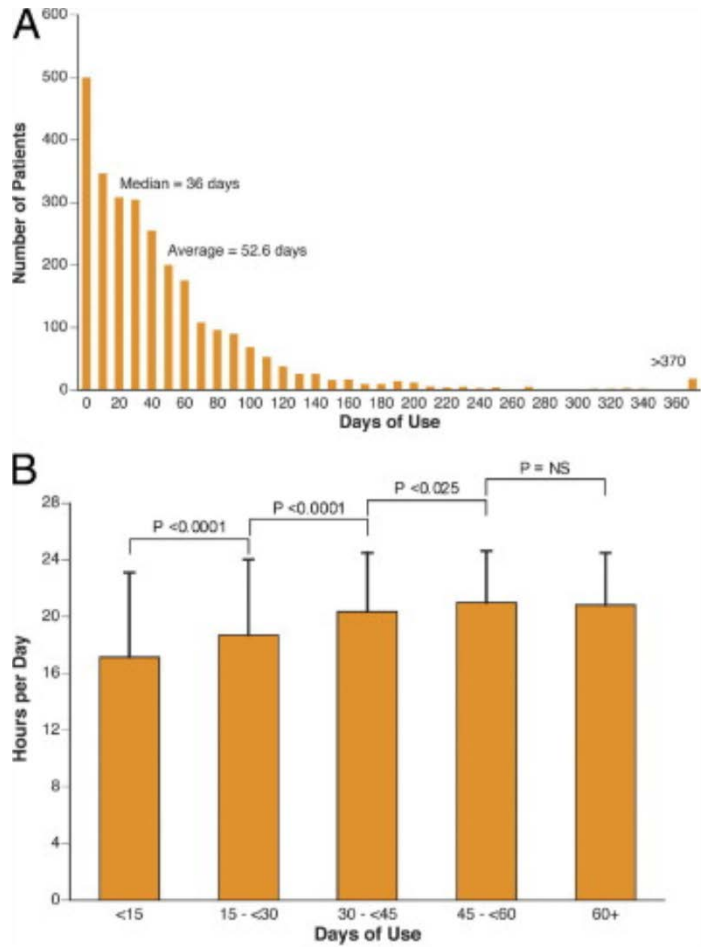
Efficacy of WCD – Inappropriate shocks

Chung, et al. 2010

Inappropriate shocks in 67 pts (1.9%)

- Signal loss (4.4%)
- Overcounting (4.4)
- Signal artifact (67.6%)
- SVT (26.5%)
- Non-sustained VT (5.9%)

J Am Coll Cardiol 2010;56:194-203



Actual WCD Use

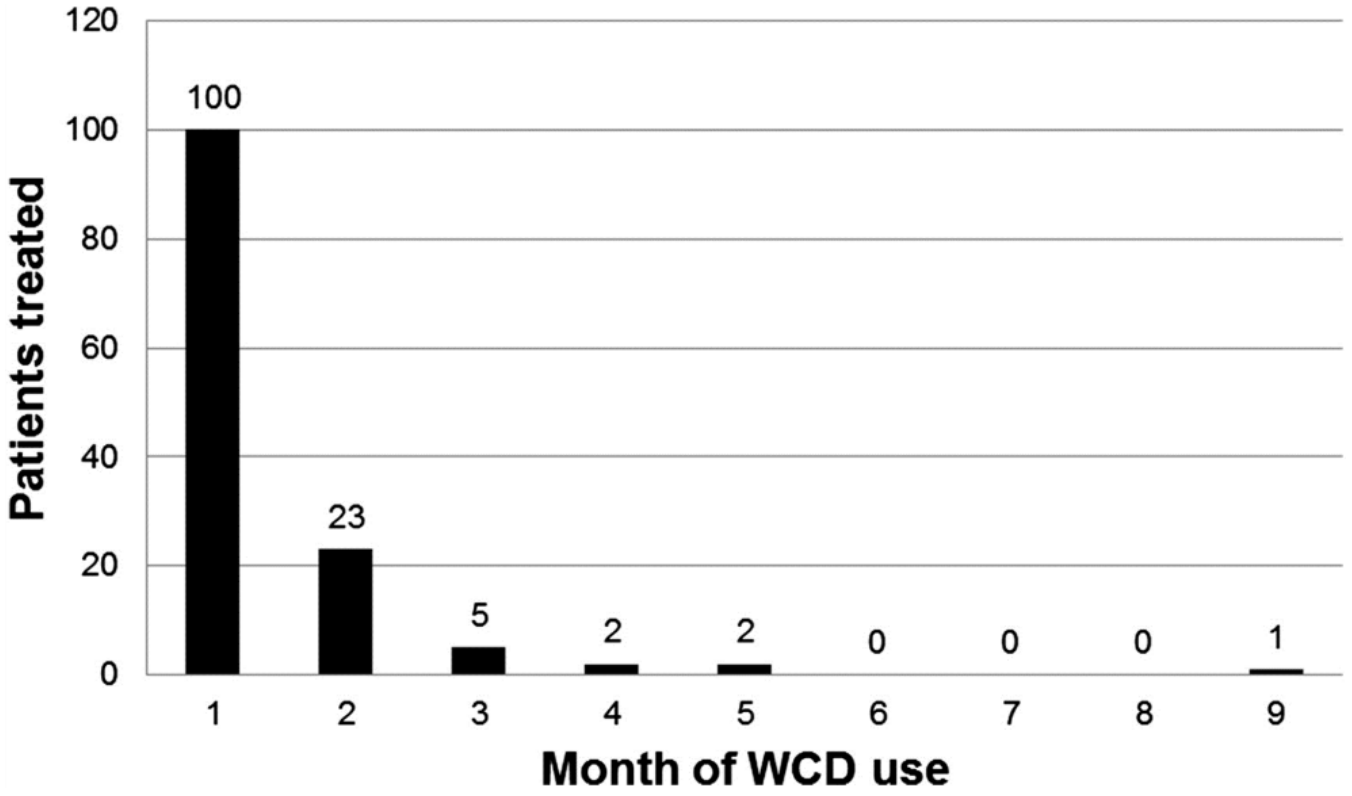
Duration of monitoring. (A) Distribution of patients by duration of wearable cardioverter-defibrillator (WCD) use. (B) Daily hours of use by overall duration of WCD use.

From: Aggregate National Experience With the Wearable Cardioverter-Defibrillator: Event Rates, Compliance, and Survival

J Am Coll Cardiol. 2010;56(3):194-203. doi:10.1016/j.jacc.2010.04.016

Efficacy of WCD

- WCD Use in Patients Perceived to be at High Risk Early Post-MI. Epstein et al. JACC 62(21)2013
  - 8,453 patients with recent MI and LVEF ≤35%
  - 133 (1.6%) received appropriate shocks from WCD
  - Median time from index MI to WCD therapy was 16 days
  - 99 patients received inappropriate shocks



Timing of WCD Shock Events

The time by month after wearable cardioverter-defibrillator (WCD) treatment was initiated to time of shock events.

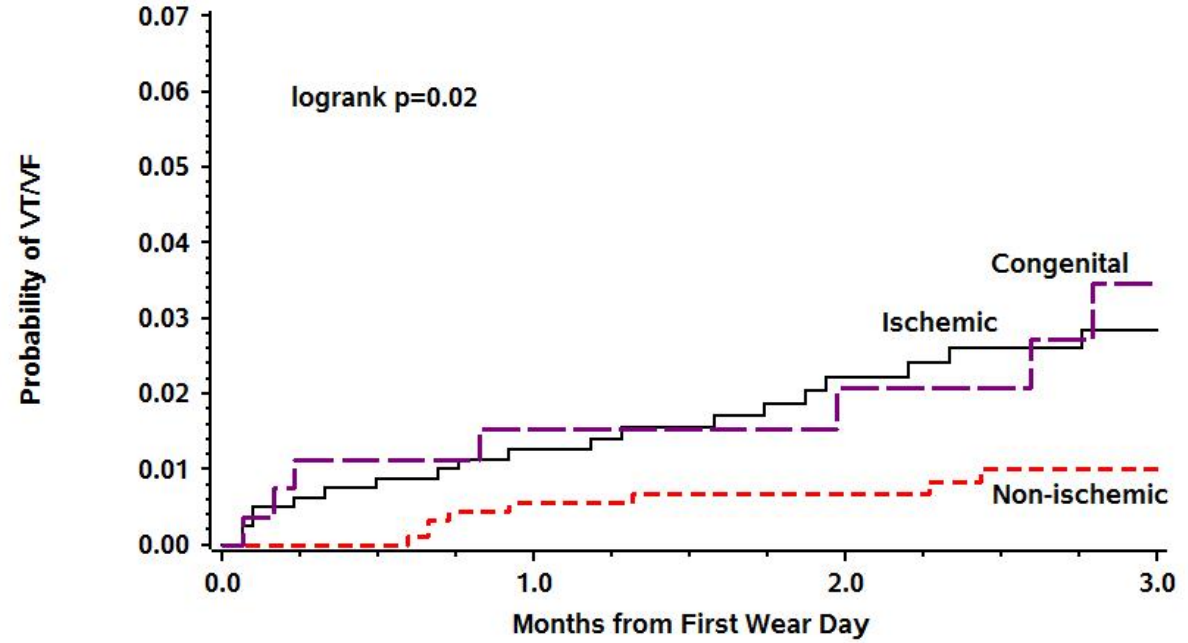
From: Wearable Cardioverter-Defibrillator Use in Patients Perceived to Be at High Risk Early Post-Myocardial Infarction

J Am Coll Cardiol. 2013;62(21):2000-2007. doi:10.1016/j.jacc.2013.05.086

WEARIT-II Registry

- Kutyifa, et al. Circulation online August 27, 2015
- Prospective study of 2000 patients, median EF 25%
- Non-ischemic CM 46%, Ischemic CM 40%, Congenital/Inherited 13.4%
- 0.5% inappropriate shocks

Efficacy of WCD in WEARIT-II Registry



Patients at Risk				
Ischemic	805	728 (0.01)	545 (0.02)	362 (0.03)
Non-ischemic	927	851 (0.01)	675 (0.01)	475 (0.01)
Congenital	268	233 (0.02)	180 (0.02)	111 (0.03)

Patient Selection

- Patients with ICD's explanted due to infection, waiting for infection to clear
- After MI and revascularization (PCI or CABG), EF <35%, before 3 month eval for ICD
- After MI without revascularization, EF <35%, before 40-day eval for ICD
- Non-ischemic cardiomyopathy, EF <35%, before 3 month eval for ICD
- Awaiting cardiac transplant
- Delay in ICD implant for genetic arrhythmia syndromes