# **Recognition and quantification** of T-Wave Alternans (TWA)

# **Risk stratification for Sudden Cardiac Death (SCD)**

#### **Definition of TWA**



#### **Rhythm Strip**



Definition: Repeating ABAB pattern in amplitude and shape of ST segment and T wave.

The TWA level shown in the QRS-aligned template (as left) is 124 microvolts. The recording is from a FINCAVAS patient who died of cardiovascular causes at ~ 1 year.

From: Minkkinen et al JCE 2009;20:408.

**Superimposed Beats** 

#### **About T-Wave Alternans**

T-Wave Alternans (TWA) is an electrophysiological phenomenon that is evident in the ECG as an alternating pattern of ST/T-Wave morphologies on successive beats. Although the alternation can be present in both the ST segment and T-Wave, the entire pattern is simply referred to as TWA.

The Modified Moving Average T-Wave Alternan (TWA) algorithm measures and quantifies the alternations on beat-to-beat patterns, precisely detecting fluctuations in the ECG waveform. TWA enables physicians to identify an often-missed pattern variation that may indicate a high level of SCD risk and helps support earlier treatment decisions.

Performing a TWA test is useful for patients who have had an MI, family history of MI and/or SCD, on beta-blockers, using an antiarrhythmic drug, or will be using an antiarrhythmic drug. Not recommended for patients with atrial fibrillation.

#### Source:

T-Wave Alternans Physician's Guide, 2020044-067 Revision C, © 2008–2009 General Electric Company.

#### **TWA preceding VT During exercise test**



# Acquiring and processing the ECG signal

### Test protocol and setup

T-Wave Alternans can be collected during a standard Holter or ECG exercise stress test.

#### Skin preparation and electrode placement

TWA is a regionally specific phenomenon. Use precordial leads

#### Modified moving average method (MMA)



## **Reviewing TWA measurements and templates**



Time synchronized trends + Templates + Raw data = Quick visual confirmation

## **Test interpretation**

## **TWA test interpretation**

- Cutpoint for abnormal results:  $\geq 47 \mu V$
- Severely abnormal:  $\geq$  60  $\mu$ V
- Larger TWA = greater risk -
- Hazard ratios for positive TWA test:

	CV Death		SCD	
		NPV		NPV
Ambulatory	2.9–17.1	97%	4.8-22.6	94%
Exercise	4.6	98%	4.4	99%

- Indeterminate tests (2-5%) may result from ventricular ectopy, technically poor readings.
- Not recommended: Assessment during AF, high-grade ectopy, supraventricular arrhythmias, or conduction block.
- CAVEAT: Results of TWA tests should be used as an adjunct to clinical history, symptoms, and the results of other noninvasive and invasive tests.



TWA  $\geq$  47  $\mu$ V = risk of SCD. TWA  $\geq$  60  $\mu$ V = severe risk of SCD. Microvolt TWA Consensus Guideline, *JACC* 2011; 44:1309–1324

Each 20-uV increase in TWA indicates +58% SCD risk. Leino et al *Heart Rhythm* 2011; **8**(3): p. 385-90

## **Further reading**

Duca ST, Roca M, Costache AD, et al. T-Wave analysis on the 24 h Holter ECG monitoring as a predictive assessment of major adverse cardiovascular events in patients with myocardial infarction: A literature review and future perspectives. Life (Basel) 2023; 13(5):1155. https://www.mdpi.com/2075-1729/13/5/1155

Aro AL, Kenttä TV, Huikuri HV. Microvolt T-wave alternans: Where are we now? Arrhythmia & Electrophysiology Review 2016; 5(1):37-40.

https://www.aerjournal.com/articles/microvolt-t-wave-alternans-where-are-we-now

Lewek J, Ptaszynski P, Klingenheben T, Cygankiewicz I. **The clinical value of T-wave** alternans derived from Holter monitoring. Europace 2017; 19(4):529-534. https://academic.oup.com/europace/article/19/4/529/2952436

You T, Luo C, Zhang K, Zhang H. Electrophysiological mechanisms underlying T-wave alternans and their role in arrhythmogenesis. Frontiers in Physiology 2021; 12:614946. https://www.frontiersin.org/articles/10.3389/fphys.2021.614946/full.

Verrier RL, Klingenheben T, Malik M, El-Sherif N, Exner D, Hohnloser S, Ikeda T, Martinez JP, Narayan S, Nieminen T, Rosenbaum DS. Microvolt T-wave alternans: Physiologic basis, methods of measurement, and clinical utility. Consensus guideline by the international Society for Holter and Noninvasive Electrocardiology. J Am Coll Cardiol 2011; 44:1309-1324.

**Abbreviations: CV** = Cardiovascular; **SCD** = Sudden Cardiac Death; **NPV** = Negative Predictive Value

Microvolt TWA Consensus Guideline, JACC 2011; 44:1309–1324

GE HealthCare

© 2024 GE HealthCare GE is a trademark of General Electric Company used under trademark license. DOC2298845 rev 1