



## Anger-Induced T-Wave Alternans Predicts Future Ventricular Arrhythmias in Patients With Implantable Cardioverter-Defibrillators

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**Objectives:** This study sought to determine whether T-wave alternans (TWA) induced by anger in a laboratory setting predicts future ventricular arrhythmias in patients with implantable cardioverter-defibrillators (ICDs).

**Background:** Anger can precipitate spontaneous ventricular tachycardia/ventricular fibrillation and induce TWA. Whether anger-induced TWA predicts future arrhythmias is unknown.

**Methods:** Sixty-two patients with ICDs underwent ambulatory electrocardiography during a mental stress protocol, 3 months after the ICD was implanted. T-wave alternans was analyzed using time-domain methods. After a  $\geq 1$  year follow-up, ICD stored data was reviewed to determine incidence of ICD-terminated ventricular tachycardia/ventricular fibrillation.

**Results:** Patients with ICD-terminated arrhythmias during follow-up ( $n = 10$ ) had higher TWA induced by anger,  $13.2 \mu\text{V}$  (interquartile range [IQR]  $9.3$  to  $16 \mu\text{V}$ ), compared with those patients without future ventricular arrhythmias,  $9.3 \mu\text{V}$  (IQR  $7.5$  to  $11.5 \mu\text{V}$ ,  $p < 0.01$ ). Patients in the highest quartile of anger-induced TWA ( $>11.9 \mu\text{V}$ ,  $n = 15$ ) were more likely to experience arrhythmias by 1 year than those in the lower quartiles (33% vs. 4%) and during extended follow-up (40% vs. 9%,  $p < 0.01$  for both). In multivariable regression controlling for ejection fraction, prior clinical arrhythmia, and wide QRS, anger-induced TWA remained a significant predictor of arrhythmia, with likelihood in the top quartile 10.8 times that of other patients (95% confidence interval: 1.6 to 113,  $p < 0.05$ ).

**Conclusions:** Anger-induced TWA predicts future ventricular arrhythmias in patients with ICDs, suggesting that emotion-induced repolarization instability may be 1 mechanism linking stress and sudden death. Whether there is a clinical role for anger-induced TWA testing requires further study.

**Key Words:** tachyarrhythmias (ventricular) • anger • implantable cardioverter-defibrillator

## **Abbreviations and Acronyms**

ICD = implantable cardioverter-defibrillator

IQR = interquartile range

TWA = T-wave alternans

VT/VF = ventricular tachycardia/ventricular fibrillation

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