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AHA/ACC/HRS Scientific Statement on Noninvasive Risk Stratification Techniques for Identifying Patients at Risk for Sudden Cardiac Death

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Sudden Cardiac Death

- **Incidence**
  - Estimated 184,000-462,000/year in U.S.
  - Only 2% - 15% reach the hospital
  - AHA “chain of survival” - early access to medical care, early CPR, early defibrillation, and early advanced care
  - Vast majority have structural heart disease, predominantly CAD

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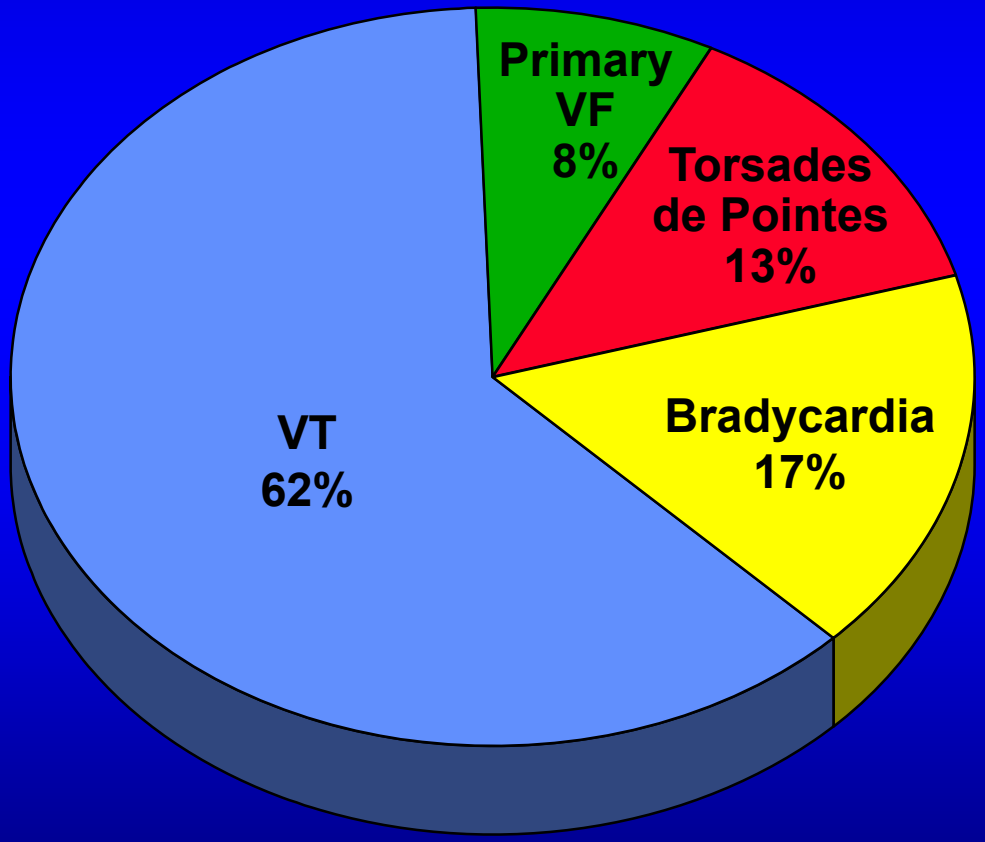
Underlying Arrhythmia of Sudden Death



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Approach to Improve Outcome Related to Sudden Cardiac Death

- Secondary prevention
  - Improve resuscitation
  - Treat survivors
- Primary prevention
  - Identify the “at risk” patient prior to the event
  - Treat the “at risk” patient

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Noninvasive Risk Stratification Techniques to Identify the "At Risk" Patient Prior to the Event

- Ejection fraction
- ECG based techniques
  - QRS duration
  - QT interval, QT dispersion
  - Signal averaged ECG
  - Short-term heart rate variability
- Baroreceptor sensitivity

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Noninvasive Risk Stratification Techniques to Identify the "At Risk" Patient Prior to the Event

- Long-term ambulatory ECG (Holter) based techniques
  - Ventricular ectopy and nonsustained VT
  - Long-term HRV
  - Heart rate turbulence
- Exercise test/functional status based techniques
  - Exercise capacity and NYHA class
  - Heart rate recovery and recovery ventricular ectopy
  - Microvolt T wave alternans

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Left Ventricular Ejection Fraction (LVEF)

Low LVEF is a well-demonstrated risk factor for SCD.

While low LVEF has been effectively used to select high risk patients for application of therapy to prevent sudden cardiac death, LVEF has limited sensitivity-the majority of SCDs occur in patients with more preserved LVEF.

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Electrocardiogram (ECG)

QRS duration	Increased QRS duration is likely a risk factor for SCD, based predominantly on retrospective analyses. Clinical utility to guide selection of therapy has not been tested.
QT interval and QT dispersion	Some data that abnormalities in cardiac repolarization are risk factors for SCD, based predominantly on retrospective analysis. Clinical utility to guide selection of therapy has not yet been tested.

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Electrocardiogram (ECG)

Signal averaged ECG (SAECG)	**Abnormal SAECG is likely a risk factor for SCD, based predominantly on prospective analyses.** **Clinical utility to guide selection of therapy has been tested, but not yet demonstrated.**
Short-term heart rate variability (HRV)	**Limited data link impaired short-term HRV to increased risk for SCD.** **Clinical utility to guide selection of therapy has not yet been tested.**

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Long-term Ambulatory ECG Recording (Holter)

Ventricular ectopy and NSVT

The presence of ventricular arrhythmias (VPBs, NSVT) on Holter monitoring is a well-demonstrated risk factor for SCD.

In some populations, the presence of NSVT has been effectively used to select high-risk patients for application of therapy to prevent sudden arrhythmic death. This may also have limited sensitivity.

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Long-term Ambulatory ECG Recording (Holter)

Long-term HRV	**Low HRV is a risk factor for mortality, but likely not specific for SCD.** **Clinical utility to guide selection of therapy has been tested, but not demonstrated.**
Heart rate turbulence	**Emerging data show that abnormal heart rate turbulence is a likely risk factor for SCD.** **Clinical utility to guide selection of therapy has not yet been tested.**

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Exercise Test/Functional Status

Exercise capacity and NYHA class	**Increasing severity of heart failure is a likely risk factor for SCD, though it may be more predictive of risk for progressive pump failure.** **Clinical utility to guide selection of therapy has not yet been tested.**
Heart rate recovery and recovery ventricular ectopy	**Limited data show that low heart rate recovery and ventricular ectopy during recovery are risk factors for SCD.** **Clinical utility to guide selection of therapy has not yet been tested.**

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Exercise Test/Functional Status

T-wave alternans

A moderate amount of prospective data suggests that abnormal T-wave alternans is a risk factor for SCD.

Clinical utility to guide selection of therapy has been evaluated, but the results, to date, are not consistent.

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Baroreceptor sensitivity (BRS)

A moderate amount of data suggest that low BRS is a risk factor for SCD.

Clinical utility to guide selection of therapy has not yet been tested.

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Other Risk Stratification Techniques to Evaluate Risk for SCD

- Stress testing for myocardial ischemia
- Electrophysiology study
- Cardiac MRI - delayed enhancement imaging

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Noninvasive Risk Stratification Techniques to Evaluate Risk for SCD in Hypertrophic Cardiomyopathy

- Prior cardiac arrest or sustained ventricular tachycardia
- Family history of a premature hypertrophic cardiomyopathy--related death
- Unexplained syncope

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Noninvasive Risk Stratification Techniques to Evaluate Risk for SCD in Hypertrophic Cardiomyopathy *Continued*

- Nonsustained ventricular tachycardia
- Attenuated or hypotensive blood pressure response to upright exercise
- Extreme left ventricular hypertrophy (≥30 mm)

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Challenges for Risk Stratification

- Risk is continuous function and not a dichotomous determination
- No consensus on level of risk that justifies an intervention
- How do we deal with time-dependent changes in risk?
- Do we need to implement a multi-component risk stratification strategy?
- Need more clinical trial data focused on risk stratification

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The full-text guideline is also available on the American Heart Association Web site:

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