Arrhythmias (II)
Ventricular Arrhythmias

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Disclosures

• None
Rhythms and Mortality

**Implantable loop recorder post-MI (CARISMA)**

- Highest hazard ratio for cardiac death and all-cause mortality was associated with high-grade AV block

**Terminal arrhythmias on ambulatory monitoring**

- 17% bradyarrhythmias
- 13% torsades
d- 62% VT, degenerating to VF
- 8% primary VF

Sudden Cardiac Death Pathology Findings (Age 35-44)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anomalous Coronary</td>
<td>30</td>
<td>40</td>
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<tr>
<td>Dissection</td>
<td></td>
<td></td>
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<tr>
<td>HCM</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>WPW</td>
<td>5</td>
<td>5</td>
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<tr>
<td>ARVD</td>
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<td>2</td>
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<tr>
<td>Sarcoid</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Congenital dz</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Undetermined</td>
<td>5</td>
<td>5</td>
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</tbody>
</table>

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ICD – Risk Stratification

- “Secondary Prevention” –
  - Hx sustained ventricular arrhythmias / aborted SCD
  - Episodes in setting of ischemia/ACS do **not** count!

- Decreased LV systolic function
  - Ischemic
    - LVEF ≤ 35% and Class II/III heart failure
    - LVEF ≤ 30%
    - LVEF ≤ 40% and (+) EPS
  - Non-ischemic
    - LVEF ≤ 35% and Class II/III heart failure
    - Genetic syndromes / high-risk diagnosis
LVEF in patients with SCD

- All cases of SCD in Multnomah County, Oregon (2002-2004)
  - 714 SCD cases, LVEF available prior to SCD in 121 (17%)

Coronary Artery Disease and VT

- *Ischemic* ventricular arrhythmias
Not all PMVT is ischemic...

“Scar-Based VT”

Electrically unexcitable scar
• dense fibrosis
• potential reentry circuit border

Reduced volume myocytes with surrounding fibrosis

Slide courtesy of William Stevenson
Monomorphic WCT

- Intrinsicsoid deflection...
  - R onset to S nadir > 100 ms
Monomorphic WCT

- Intrinsicoid deflection
- AV dissociation
  - Fusion and Capture beats suggest A/V dissociation
AV dissociation (ICD)
Monomorphic WCT

- Intrinsicoid deflection
- AV dissociation
- Concordance
  - No Q or S (positive concordance) in precordial leads
  - No R (QS only) (negative concordance) in precordial leads

This is not Concordance
Monomorphic WCT

- Intrinsicoid deflection
- AV dissociation
- Concordance
- Morphology criteria

RBBB Pattern
- V1 – lack of rabbit ears
  - monophasic R
  - qR / Rs
- V6
  - S>R
  - QS

LBBB Pattern
- V1/V2 –
  - R>30 ms
  - Intrinsicoid deflection >60 ms
- V6
  - qR or qS

RBBB without rabbit ears

But more importantly, known iCMP
RBBB with V6 S>R

More telling…Baseline EKG
The rules aren’t perfect…

High Risks Syndromes / Diagnoses

- Sarcoid
- ARVC
- Brugada
- Long QT
- Hypertrophic cardiomyopathy
- CPVT
- Short QT
Cardiac Sarcoidosis
(Idiopathic Granulomatous Myocarditis)

- Cardiac involvement in estimated ≥25% of patients with sarcoidosis in US
  - ~50% not diagnosed until time of autopsy
- Clinical presentation
  - Heart failure
  - Conduction disease (heart block)
  - Ventricular arrhythmias
- Imaging (e.g., PET, MRI) can help with diagnosis

Arrhythmogenic RV dysplasia

- Fatty / fibrous replacement of myocardium, classically in RV although LV can be affected
  - Dilated or aneurysmal RV
- Ventricular arrhythmias frequently observed
- ECG: can have suggestive features but can be normal
  - t-wave inversion in V1 – V3 without RBBB (~85%)
  - QRS>110 ms V1-V3 (64%)
  - Epsilon wave in ~30%

Brugada Patterns

Type 1

“Coved” ST

Negative T wave

ST terminal segment gradually descending

Type 2

Saddleback ST

Positive / Biphasic T

ST terminal segment elevated ≥1 mm

Type 3

Saddleback ST

Positive T

ST terminal segment elevated <1 mm
**Congenital Long QT Syndrome**

**LQT1**
- potassium channel mutation (Iks)
- SCD associated with swimming
- beta blocker significantly protective

**LQT2**
- potassium channel mutation (Ikr)
- SCD associated with emotional episodes, sound stimuli (alarm clock)
- beta blocker decreases risk

**LQT3**
- sodium channel mutation
- SCD associated with sleep
- beta blockers of unclear/limited benefit

Hypertrophic Cardiomyopathy

- Predictors of risk –
  - Family hx cardiac arrest
  - History of VT / cardiac arrest
  - Unexplained syncope
  - NVST on Holter monitor
  - Severe wall thickness ($\geq 30$mm)
  - Abnormal blood pressure response to exercise
  - Microvascular obstruction
  - High-risk genetic defect
  - LV outflow tract obstruction

Rare syndromes

- Catecholaminergic Polymorphic VT
  - RyR2 & CASQ2 mutations $\to$ Ca$^{2+}$ leak from SR $\to$ cytosolic Ca$^{2+}$ overload $\to$ transient inward current $\to$ delayed after depolarizations
  - Syncope triggered by physical/emotional stress
    - Family history of stress-induced syncope common
  - Baseline ECG, cardiac exam & imaging unremarkable
  - High mortality (>25% by age 30)
  - Treated with BB / CCB

- Short QT Syndrome
  - Potassium channel mutation, autosomal dominant
  - Structurally normal heart
  - QTc <320 ms
  - Associated with atrial and ventricular arrhythmias
Ventricular Automaticity -
Idiopathic VT

- Structurally normal heart
  - Subtle abnormalities should be excluded (e.g., cardiac MRI)
- Generally has a good prognosis
- Typically enhanced automaticity from a focus around the pulmonic, aortic, mitral, or tricuspid valve annulus
  - “RVOT” is common variant
- Can be incessant or paroxysmal
Re-entrant Idiopathic VT

- LV septal VT (verapamil-sensitive, fascicular, Bellhassen's VT)
  - Re-entrant
  - RBBB/LAD with narrow QRS
  - Responds to verapamil
  - Can be confused with SVT

Hemodynamically Stable
Regular, Wide QRS tachycardia

Definite SVT

Possible VT

- procainamide
- amiodarone
- lidocaine (sotalol)

Keep in mind...
- lytes (Mg, K)
- drug toxicity

Cardioversion

ACC/AHA/ESC guidelines 2003 www.americanheart.org

Slide courtesy of William Stevenson
Management Options in Patients with VT

• ICD
  – Frequent therapies are NOT a good solution
Management Options in Patients with VT

- ICD
  - Frequent therapies are NOT a good solution
- Drugs
  - Single or multi-drug regimens
- Ablation
  - Generally successful at reducing VT burden, if not eliminating it
  - No longer a 3rd line approach!!

A 45 year old man collapses on the golf course, is resuscitated from VF with an AED, and is found to have an acute occlusion of his LAD, which is stented. Which of the following is correct?

1. He should receive an ICD for secondary prevention.
2. If he has ventricular ectopy after PCI, he should receive an ICD
3. He should receive an ICD if his LVEF on TTE during the index hospitalization is under 35%
4. He should receive an ICD if his LVEF on TTE during the index hospitalization is under 30%.
5. Candidacy for ICD implantation should be deferred for 90 days
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In considering candidacy for a defibrillator in a patient without a history of sustained ventricular arrhythmias and without a known genetic syndrome, all of the following should be considered EXCEPT -

1. Left ventricular systolic function
2. Life expectancy and anticipated quality of life
3. Functional status
4. T wave alternans testing
5. Timing of last myocardial infarction and/or revascularization
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References – ACC/AHA Guidelines


