Sudden Cardiac Death
....and what you can do to prevent it!

Mini Medical School for the Public
San Francisco, CA
June 10, 2015

Byron K. Lee MD
Professor of Medicine
Director of EP Laboratory
Division of Cardiology
Cardiac Electrophysiology

Disclosures

• Biotronik
  – Consulting-Modest
  – Honorarium-Modest

• Boston Scientific
  – Honorarium-Modest

• CardioNet
  – Consulting-Moderate

• Zoll Medical
  – Research Support- Significant

Final Word on Nutritional Studies

It's a relief to know the truth after all those conflicting reports.

1. The Japanese eat very little fat
   And suffer fewer heart attacks than Americans.

2. The Mexicans eat a lot of fat
   and suffer fewer heart attacks than Americans.

3. The Chinese drink very little red wine
   and suffer fewer heart attacks than Americans.

4. The Italians drink a lot of red wine
   and suffer fewer heart attacks than Americans.

5. The Germans drink a lot of beers and eat lots of sausages and fats
   and suffer fewer heart attacks than Americans.
Final Word on Nutritional Studies

Conclusions:

1. Eat and drink what you like.
2. Speaking English is apparently what kills you.

Magnitude of SCD in the US

SCD claims more lives each year than these other diseases combined

#1 Killer in the U.S. 450,000

SCD 4

Sudden Death ≠ Heart Attack

- Heart attacks are caused by a sudden blockage of the coronary artery
  - Heart attacks usually cause chest pain
  - Heart attacks only sometimes cause sudden death

Causes of SCD (Age>35)

- Uncommon causes
- Cardiomyopathy
- Risk factors for coronary atherosclerosis
  - Older age, male sex, hyperlipidemia, smoking, hypertension, diabetes

Causes of SCD (age<35)

<table>
<thead>
<tr>
<th>Cause</th>
<th>No. of Athletes</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>102</td>
<td>28.4</td>
</tr>
<tr>
<td>Conduction defects</td>
<td>77</td>
<td>19.9</td>
</tr>
<tr>
<td>Congenital anomalies</td>
<td>53</td>
<td>13.7</td>
</tr>
<tr>
<td>Left ventricular hypertrophy of idiopathic</td>
<td>29</td>
<td>7.5</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>23</td>
<td>5.2</td>
</tr>
<tr>
<td>Ruptured aortic aneurysm (Marfan’s syndrome)</td>
<td>12</td>
<td>3.1</td>
</tr>
<tr>
<td>Hypertrophic right ventricular cardiomyopathy</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Ventricular hypertrabeculation (Marfan’s syndrome)</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Antineutrophil cytoplasmic antibodies</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Arrhythmogenic right ventricular cardiomyopathy</td>
<td>11</td>
<td>2.8</td>
</tr>
<tr>
<td>Dilated cardiomyopathy</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>Nonischemic mitral valve degeneration</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>Heart stroke</td>
<td>6</td>
<td>1.6</td>
</tr>
<tr>
<td>Drug abuse</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Other cardiovascular cause</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Long QT syndrome</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Cardiac arrhythmias</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Trauma-related ventricular arrhythmies</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Ruptured aortic aneurysm (Marfan’s syndrome)</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Ruptured ventricular aneurysm</td>
<td>2</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Causes of SCD (age<35)

- #1: Hypertrophic CM
  - 1 in 500
  - Scarred and disordered myocardium
  - Confirmed HCM in 26.4% of SCDs
  - Probable HCM in 7.5% additional cases of SCD
- Diagnosis
  - PE
  - ECG
  - Echo

ECG in Hypertrophic CM

Hypertrophic CM: Hank Gathers

Athlete’s Heart

- Triggers
  - Endurance sports (rowing, cross country skiing, swimming)
  - Isometric sports (weightlifting, wrestling)
- Cardiac changes
  - Heart size and chamber enlargement
  - Increased LV wall thickness
  - Increased LA
  - Preservation of systolic and diastolic function
- Associated with abnormal ECG patterns
- Considered a benign adaptation to training
17 year old Swimmer

- Referred for Abnormal ECG
- Sees you for evaluation
  - No syncope
  - No symptoms of cardiac disease
  - No FH of SCD
  - Appears to be extremely physically fit
  - Rest of exam benign except for a soft systolic murmur

17 year old Swimmer

- Echo
  - Significant concentric LVH with maximal wall thickness of 14 mm (normal <12 mm)
  - Normal LV cavity of 48 mm
  - Normal systolic and diastolic function
  - Normal valves
- MRI normal except for wall thickening
- ETT normal
- 24 hour holter normal
- Now what?
Causes of SCD (age<35)

- #2: Commotio Cordis
  - Blunt blow to the chest 15-30ms before T-wave peak (vulnerable phase of repolarization)
  - Mean age 13 years old
  - Compliant chest wall
  - 19.9% of SCDs
  - Structural normal heart
  - Normal ECG
Sudden Cardiac Death

Protection Against Commotio Cordis

Causes of SCD (age<35)

- #3: Congenital Coronary Artery Anomalies
  - Artery arises from wrong aortic sinus
  - Classic presentation: CP or syncope with exercise
  - 13.7% of SCDs
  - Diagnosis:
    - Stress test
    - Echo
    - MRI
    - CT
    - Cath
    - Normal ECG

Coronary-Artery Anomalies: Pete Maravich
EKG

Holter

Cardiologist might also Order

- Echocardiogram
- Exercise Treadmill Test

Implantable Event Monitor
Cardiologist might also order:
- Cardiac Catheterization
- Electrophysiology Test

Slow HR due to Complete Heart Block with Ventricular Escape

Arne Larsson: First PPM patient
Pathophysiology: SCN5A Na Channel

- Green: mutations causing Brugada Syndrome
- Red: mutations causing Long QT Syndrome

Brugada Syndrome

- **Lai tai**
  - "Death during sleep"

- **Pokkuri**
  - "Unexpected death during sleep"

- **Bangungut**
  - "Scream followed by sudden death during sleep"

- **Phillippines**: Depicted as a mythological creature called Batibat
  - Hag-like creature sits on victims face or chest to suffocate or immobilize him
Resuscitation Success vs. Time*

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>% Success</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>80</td>
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<tr>
<td>3</td>
<td>70</td>
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<tr>
<td>4</td>
<td>60</td>
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<td>5</td>
<td>50</td>
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<td>6</td>
<td>40</td>
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<tr>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Chance of success reduced 7 - 10% each minute


External Defibrillation

What do you do?
- 1. Check responsiveness
- 2. Call 911

Automatic External Defibrillator (AED)
What do you do?

1. Check responsiveness
2. Call 911
3. Use AED if available

Two steps to save a life:

1. Call 911
2. Push hard and fast in the center of the chest

Traditional CPR: ABC

What do you do?

1. Check responsiveness
2. Call 911
3. Use AED if available
4. Start hands only CPR
**Unwitnessed Sudden Cardiac Arrest**

Brittany Murphy  
Cardiac Arrest in Bathroom  
Age 32

Bobbi Kristina Brown  
Cardiac Arrest in Bathtub  
Age 21

**History of ICD Therapy**

- 1966 – Conception
- 1969 – First experimental model
- 1975 -- First animal implant
- 1980 -- First human implant
- 1985 -- FDA approval

**Original Mirowski AID (ICD)**

Dr. Morowski
ICDs Save Lives

Conclusions

• Most SCD is a common cause of death
• Main cause of SCD
  – Over 35: CAD
  – Under 35: HCM, Commotio Cordis, Coronary Anomalies
• Cardiac Arrest
  – 1. Check responsiveness
  – 2. Call 911
  – 3. Use AED if available
  – 2. Start hands only CPR
• Pacemakers and ICDs save lives
• Guest speaker: Mr. Alan Liss
  – Getting diagnosed with Heart Disease
  – ICD implantation
  – Cardiac arrest