Syncope

A Diagnostic and Treatment Strategy
The Significance of Syncope

The only difference between syncope and sudden death is that in one you wake up.¹

The Significance of Syncope

- More than 1 million patients in the U.S.\(^1\)
- More than 500,000 new patients per year\(^1\)
- 1–6% of admissions\(^2,3,4\)
- 3% of emergency room visits per year\(^3\)

1. National Disease and Therapeutic Index on Syncope and Collapse, ICD-9-CM 780.2, IMS America, 1997
Syncope Reported Frequency

- Individuals <18 yrs
  - 15%

- Military Population 17-46 yrs
  - 20-25%

- Individuals 40-59 yrs*
  - 16-19%

- Individuals >70 yrs*
  - 23%

*during a 10-year period

The Significance of Syncope

- 500,000 new syncope patients each year
- 170,000 have recurrent syncope
- 70,000 have recurrent, infrequent, unexplained syncope

infrequent, unexplained: 38% to 47% ¹⁻⁴
explained: 53% to 62%

5 National Disease and Therapeutic Index, IMS America, Syncope and Collapse #780.2; Jan 1997-Dec 1997.
The Significance of Syncope

- Some causes of syncope are potentially fatal
- Cardiac causes of syncope have the highest mortality rates

Syncope: A Symptom...Not a Diagnosis

- Self-limited loss of consciousness and postural tone
- Relatively rapid onset
- Variable warning symptoms
- Spontaneous complete recovery
Syncope: Etiology

Neurally-Mediated
1. Vasovagal
2. Carotid Sinus
3. Situational
   - Cough
   - Post-micturition
24%

Orthostatic
2. Drug Induced
   - ANS Failure
   - Primary
   - Secondary
11%

Cardiac Arrhythmia
3. Brady
   - Sick sinus
   - AV block
3. Tachy
   - VT
   - SVT
4. Long QT Syndrome
14%

Structural Cardio-Pulmonary
4. Aortic Stenosis
5. HOCM
6. Pulmonary Hypertension
4%

Non-Cardiovascular
5. Psychogenic
6. Metabolic e.g. hyper-ventilation
7. Neurological
12%

Unknown Cause = 34%

DG Benditt, UM Cardiac Arrhythmia Center
Causes of Syncope-like States

- Migraine*
- Acute hypoxemia*
- Hyperventilation*
- Somatization disorder (psychogenic syncope)
- Acute Intoxication (e.g., alcohol)
- Seizures
- Hypoglycemia
- Sleep disorders

* may cause ‘true’ syncope
Initial Evaluation
(Clinic/Emergency Dept.)

- Detailed history
- Physical examination
- 12-lead ECG
- Echocardiogram (as available)
<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(based on mean time to diagnosis of 5.1 months)</strong></td>
<td></td>
</tr>
<tr>
<td>History and Physical</td>
<td>49-85%</td>
</tr>
<tr>
<td>(including carotid sinus massage)</td>
<td>1, 2</td>
</tr>
<tr>
<td>ECG</td>
<td>2-11%</td>
</tr>
<tr>
<td>Electrophysiology Study without SHD*</td>
<td>11%</td>
</tr>
<tr>
<td>Electrophysiology Study with SHD</td>
<td>49%</td>
</tr>
<tr>
<td>Tilt Table Test (without SHD)</td>
<td>11-87%</td>
</tr>
<tr>
<td>Ambulatory ECG Monitors:</td>
<td></td>
</tr>
<tr>
<td>▪ Holter</td>
<td>2%</td>
</tr>
<tr>
<td>▪ External Loop Recorder (2-3 weeks duration)</td>
<td>20%</td>
</tr>
<tr>
<td>▪ Insertable Loop Recorder (up to 14 months duration)</td>
<td>65-88%</td>
</tr>
<tr>
<td>Neurological †</td>
<td>0-4%</td>
</tr>
</tbody>
</table>

† MRI not studied

7 Krahn, Cardiology Clinics, 1997.
Syncope
Evaluation and Differential Diagnosis

History – What to Look for

- Complete Description
  - From patient and observers
- Type of Onset
- Duration of Attacks
- Posture
- Associated Symptoms
- Sequelae
12-Lead ECG

- Normal or Abnormal?
  - Acute MI
  - Severe Sinus Bradycardia/pause
  - AV Block
  - Tachyarrhythmia (SVT, VT)
  - Preexcitation (WPW), Long QT, Brugada

- Short sampling window (approx. 12 sec)
Carotid Sinus Massage

- **Site:**
  - Carotid arterial pulse just below thyroid cartilage

- **Method:**
  - Right followed by left, pause between
  - Massage, NOT occlusion
  - Duration: 5-10 sec
  - Posture – supine & erect
Carotid Sinus Massage

- **Outcome:**
  - 3 sec asystole and/or 50 mmHg fall in systolic blood pressure with reproduction of symptoms = Carotid Sinus Syndrome (CSS)

- **Contraindications**
  - Carotid bruit, known significant carotid arterial disease, previous CVA, MI last 3 months

- **Risks**
  - 1 in 5000 massages complicated by TIA
Head-up Tilt Test (HUT)

- Unmasks VVS susceptibility
- Reproduces symptoms
- Patient learns VVS warning symptoms
- Physician is better able to give prognostic / treatment advice
Randomized Assessment of Syncope Trial

Unexplained Syncope
after history, physical exam, ECG, Holter

Low Risk (EF > 35%)

ILR

- +

External loop recorder
Tilt test, EPS, others

Usual care including:
External loop recorder
Tilt test, EPS and others

Diagnosis

+ -

ILR

Unexplained Syncope Diagnosis

History and Physical Exam
- Surface ECG

Neurological Testing
- Head CT Scan
- Carotid Doppler
- MRI
- Skull Films
- Brain Scan
- EEG

CV Syncope Workup
- Holter
- ELR or ILR
- Tilt Table
- Echo
- EPS

Psychological Evaluation

Other CV Testing
- Angiogram
- Exercise Test
- SAECG

Endocrine Evaluation

ENT Evaluation

Typical Cardiovascular Diagnostic Pathway

Syncope

History and Physical, ECG

Known SHD

Echo

EPS

- Tilt/ILR

+ Treat

No SHD

> 30 days; > 2 Events

Tilt

ILR

< 30 days

Tilt

Holter/ ELR

ILR

Adapted from:
Neurally-Mediated Reflex Syncope (NMS)

- Vasovagal syncope (VVS)
- Carotid sinus syndrome (CSS)
- Situational syncope
  - post-micturition
  - cough
  - swallow
  - defecation
  - blood drawing
  - etc.
Vasovagal Syncope (VVS): Clinical Pathophysiology

- Neurally Mediated Physiologic Reflex Mechanism with two Components:
  - Cardioinhibitory (↓ HR)
  - Vasodepressor (↓ BP)

- Both components are usually present
Prevalence of VVS

- Prevalence is poorly known
  - Various studies report 8% to 37% (mean 18%) of cases of syncope (Linzer 1997)

- In general:
  - VVS patients younger than CSS patients
  - Ages range from adolescence to elderly (median 43 years)
  - Pallor, nausea, sweating, palpitations are common
  - Amnesia for warning symptoms in older patients
Management Strategies for VVS

- Optimal management strategies for VVS are a source of debate
  - Patient education, reassurance, instruction
  - Fluids, salt, diet
  - Tilt Training
  - Support hose

- Drug therapies

- Pacing
  - Class II indication for VVS patients with positive HUT and cardioinhibitory or mixed reflex
Carotid Sinus Syndrome (CSS)

- Syncope clearly associated with carotid sinus stimulation is rare (≤1% of syncope)

- CSS may be an important cause of unexplained syncope / falls in older individuals
Carotid Sinus Hypersensitivity (CSH)

- Abnormal response to CSM
- Absence of symptoms attributable to CSS
- CSH reported frequent in ‘fallers’ (Kenny)

CSH ≠ CSS
VVS: Pharmacologic Rx

- **Salt /Volume**
  - Salt tablets, ‘sport’ drinks, fludrocortisone

- **Beta-adrenergic blockers**
  - 1 positive controlled trial (atenolol),
  - 1 on-going RCT (POST)

- **Disopyramide**

- **SSRIs**
  - 1 controlled trial

- **Vasoconstrictors (e.g., midodrine)**
  - 1 negative controlled trial (etilephrine)
Midodrine for Neurocardiogenic Syncope

![Graph showing symptom-free interval over months with Midodrine and Fluid treatments compared. The p-value is less than 0.001.]

Principal Causes of Orthostatic Syncope

- Drug-induced (very common)
  - diuretics
  - vasodilators
- Primary autonomic failure
  - multiple system atrophy
  - Parkinsonism
- Secondary autonomic failure
  - diabetes
  - alcohol
  - amyloid
- Alcohol
  - orthostatic intolerance apart from neuropathy
Syncope Due to Arrhythmia or Structural CV Disease: General Rules

- Often life-threatening and/or exposes patient to high risk of injury
- May be warning of critical CV disease
  - Aortic stenosis, Myocardial ischemia, Pulmonary hypertension
- Assess culprit arrhythmia / structural abnormality aggressively
- Initiate treatment promptly
Principal Causes of Syncope due to Structural Cardiovascular Disease

- Acute MI / Ischemia
  - Acquired coronary artery disease
  - Congenital coronary artery anomalies
- HOCM
- Acute aortic dissection
- Pericardial disease / tamponade
- Pulmonary embolus / pulmonary hypertension
- Valvular abnormalities
  - Aortic stenosis, Atrial myxoma
Syncope Due to Cardiac Arrhythmias

- Bradyarrhythmias
  - Sinus arrest, exit block
  - High grade or acute complete AV block

- Tachyarrhythmias
  - Atrial fibrillation / flutter with rapid ventricular rate (e.g. WPW syndrome)
  - Paroxysmal SVT or VT
  - Torsades de pointes
Syncope: Torsades
83 yo woman
Bradycardia: Pacemaker implanted

28 yo man in the ER multiple times after falls resulting in trauma
VT: ablated and medicated

Reveal® ILR recordings; Medtronic data on file.
Drug-Induced QT Prolongation

- **Antiarrhythmics**
  - *Class IA* … Quinidine, Procainamide, Disopyramide
  - *Class III* … Sotalol, Ibutilide, Dofetilide, Amiodarone, (NAPA)

- **Antianginal Agents**
  - (Bepridil)

- **Psychoactive Agents**
  - Phentothiazines, Amitriptyline, Imipramine, Ziprasidone

- **Antibiotics**
  - Erythromycin, Pentamidine, Fluconazole

- **Nonsedating antihistamines**
  - (Terfenadine), Astemizole

- **Others**
  - (Cisapride), Droperidol
Treatment of Syncope Due to Bradyarrhythmia

- Class I indication for pacing using dual-chamber system wherever adequate atrial rhythm is available
- Ventricular pacing in atrial fibrillation with slow ventricular response
Treatment of Syncope Due to Tachyarrhythmia

- Atrial Tachyarrhythmias;
  - AVRT due to accessory pathway – ablate pathway
  - AVNRT – ablate AV nodal slow pathway
  - Atrial fib – Pacing, linear / focal ablation, ICD selected pts
  - Atrial flutter – Ablation of reentrant circuit

- Ventricular Tachyarrhythmias;
  - Ventricular tachycardia – ICD or ablation where appropriate
  - Torsades de Pointes – withdraw offending Rx or ICD (long-QT/Brugada)

- Drug therapy may be an alternative in many cases
Conclusion

Syncope is a common symptom, often with dramatic consequences, which deserves thorough investigation and appropriate treatment of its cause.
Sudden Cardiac Death in Young Athletes
Athlete SCD—why is it important

- Family physicians see a lot of athletes for sports related issues
- Family physicians are involved in school health and pre-participation examinations
- It is important to know the clinical characteristics of SCD and identify athletes who are at risk
- It is important to know the current recommendations for pre-participation examinations
What do we know about SCD in Athletes?

- 12-15 million young (<30 years) competitive athletes in the US
- Estimated incidence of sudden cardiac death at 2.1 per 100,000 athletes per year
- Estimated 200 athletes in the US die per year of sudden cardiac death
- Sudden death of the young athletes is mostly unexpected, dramatic, tragic and carries huge emotional impact on the society
Epidemiology Based on Autopsy Series

- **Age**
  - 9% in middle school
  - 62% in high school
  - 22% in college
  - 7% in professional

- **Sex**—90% male, 10% female

- Caucasians at highest risk

Maron BJ et al, JAMA 1996; 276: 199 - 203
Sports engaged in at the time of sudden death

Maron BJ et al, JAMA 1996; 276: 199 - 203
Coronary Artery Anomaly

Fig. 1. Diagram showing anomalous origin of left main coronary artery from right aortic sinus with retroaortic coursing of anomalistically arising artery.
Coronary Artery Anomaly

- With increased stroke volume during exercise, the ascending aorta expands and the take-off angle is further exaggerated.
- LMCA may also be compressed against the root of the pulmonary trunk during exercise.
- ECG is likely normal.
- Very difficult to screen or diagnose even with echocardiogram.
- Treatment: Surgery for coronary reimplantation.
Commotio Cordis

- Sudden disturbance of heart rhythm as the result of a blunt, non-penetrating impact to the precordial region

- Impact occurring within a specific 10-20 millisecond portion of the cardiac cycle in the ascending phase of the T wave, when the ventricular myocardium is repolarizing, moving from systole to diastole

- Most effective preventions are:
  - Chest shield
  - Automatic External Defibrillator (AED)
European Guidelines for PPE

- In 2005, The European Society of Cardiology issued official recommendation for PPE, including 12-lead ECG
TABLE. The 12-Element AHA Recommendations for Preparticipation Cardiovascular Screening of Competitive Athletes

<table>
<thead>
<tr>
<th>Medical history*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal history</td>
</tr>
<tr>
<td>1. Exertional chest pain/discomfort</td>
</tr>
<tr>
<td>2. Unexplained syncope/near-syncope†</td>
</tr>
<tr>
<td>3. Excessive exertional and unexplained dyspnea/fatigue, associated with exercise</td>
</tr>
<tr>
<td>4. Prior recognition of a heart murmur</td>
</tr>
<tr>
<td>5. Elevated systemic blood pressure</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Family history</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Premature death (sudden and unexpected, or otherwise) before age 50 years due to heart disease, in ≥1 relative</td>
</tr>
<tr>
<td>7. Disability from heart disease in a close relative &lt;50 years of age</td>
</tr>
<tr>
<td>8. Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long-QT syndrome or other ion channelopathies, Marfan syndrome, or clinically important arrhythmias</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Heart murmur†</td>
</tr>
<tr>
<td>10. Femoral pulses to exclude aortic coarctation</td>
</tr>
<tr>
<td>11. Physical stigmata of Marfan syndrome</td>
</tr>
<tr>
<td>12. Brachial artery blood pressure (sitting position)§</td>
</tr>
</tbody>
</table>

*Parental verification is recommended for high school and middle school athletes.
†Judged not to be neurocardiogenic (vasovagal); of particular concern when related to exertion.
AHA Consensus Panel Recommendations for Preparticipation Athletic Screening

Family History
1. Premature sudden cardiac death
2. Heart disease in surviving relatives less than 50 years old

Personal History
3. Heart murmur
4. Systemic hypertension
5. Fatigue
6. Syncope/near-syncope
7. Excessive/unexplained exertional dyspnea
8. Exertional chest pain

Physical Examination
9. Heart murmur (supine/standing*)
10. Femoral arterial pulses (to exclude coarctation of aorta)
11. Stigmata of Marfan syndrome
12. Brachial blood pressure measurement (sitting)