Syncope
Risk Stratification at ED

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Overview
- Clinical Significance
- Etiology
- Evaluation
- Risk Stratification

Clinical Significance
- Impact of Syncope

Impact of Syncope

- Anxiety/Depression
- Restricted Daily Activities
- Restricted Driving
- Change Employment

Causes

<table>
<thead>
<tr>
<th>Cause</th>
<th>Prevalence (Mean) %</th>
<th>Prevalence (Range) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflex-mediated:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vasovagal</td>
<td>18</td>
<td>8-37</td>
</tr>
<tr>
<td>Situational</td>
<td>5</td>
<td>1-8</td>
</tr>
<tr>
<td>Carotid Sinus</td>
<td>1</td>
<td>0-4</td>
</tr>
<tr>
<td>Orthostatic Hypotension</td>
<td>8</td>
<td>4-10</td>
</tr>
<tr>
<td>Medications</td>
<td>3</td>
<td>1-7</td>
</tr>
<tr>
<td>Psychiatric</td>
<td>2</td>
<td>1-7</td>
</tr>
<tr>
<td>Neurological</td>
<td>10</td>
<td>3-32</td>
</tr>
<tr>
<td>Organic Heart Disease</td>
<td>4</td>
<td>1-8</td>
</tr>
<tr>
<td>Cardiac-Arrhythmias</td>
<td>14</td>
<td>4-38</td>
</tr>
<tr>
<td>Unknown</td>
<td>34</td>
<td>13-41</td>
</tr>
</tbody>
</table>
Causes based on Underlying Cardiovascular Status

<table>
<thead>
<tr>
<th>Cause</th>
<th>Cardiac Origin (%)</th>
<th>Orthostatic (%)</th>
<th>Structural (%)</th>
<th>unknown (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>M=691</td>
<td>M=822</td>
<td>M=801</td>
<td></td>
</tr>
<tr>
<td>Disorders</td>
<td>(N=218)</td>
<td>(N=257)</td>
<td>(N=228)</td>
<td>(N=618)</td>
</tr>
<tr>
<td>Complaints</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>3.3</td>
<td>3.1</td>
<td>1.9</td>
<td>9.5</td>
</tr>
<tr>
<td>Disorders</td>
<td>16.8</td>
<td>16.8</td>
<td>26.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Unknown*</td>
<td>12.3</td>
<td>12.3</td>
<td>21.0</td>
<td>6.6</td>
</tr>
<tr>
<td>Nonspecific</td>
<td>2.3</td>
<td>2.3</td>
<td>9.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Vasovagal</td>
<td>9.3</td>
<td>9.3</td>
<td>6.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>5.0</td>
<td>5.0</td>
<td>6.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Situational</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Cough</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Postmicturition</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Drug induced</td>
<td>1.7</td>
<td>1.7</td>
<td>9.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Brady</td>
<td>1.7</td>
<td>1.7</td>
<td>9.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Syncope</td>
<td>22%</td>
<td>12%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>Neurally mediated</td>
<td>22%</td>
<td>12%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>Cardiac arrhythmia</td>
<td>12%</td>
<td>12%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>Structural cardiovascular</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>Non-cardiovascular</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Etiology

D/D: Syncope Mimics

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

* May cause true syncope

Differential Diagnosis

- Primary objectives:
  - Distinguish ‘true syncope’ from syncope mimics:
    - Seizures
    - Psychiatric disturbances
- Secondary objectives:
  - Assess prognosis
  - Effective prevention

Initial Evaluation

- Detailed History & Physical Examination
  - Details of events
  - Assess frequency, severity
  - Careful family history
- Cardiac Origin?
  - Physical exam
  - 12-Lead ECG: long QT, WPW, conduction system dz.
  - Echo: LV function, valve status, HOCM
- Diagnostic Algorithm

Event Details

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

- Normal or Abnormal?
- Low or High Risk?
  - Acute MI
  - Severe Sinus Bradycardia/Pause
  - AV Block / BBB (?)
  - Tachyarrhythmia (SVT, VT)
  - Preexcitation (WPW), Long QT, Brugada
  - LVH (?)

High Risk 12-Lead ECG

- Extensive Antero-lateral MI
- Inferior MI, high grade AV block and PVC
- Acute Inferior MI
- AMI (Latero-inferior?) With RBBB
Pacemaker rhythm with AMI (inferior)

Brugada Syndrome

Aortic Valve Stenosis

HOCM

Arrhythmogenic RV dysplasia

RVH (PPH)
**WPW Syndrome**

**High Risk 12-Lead ECG**

**Long QT Syndrome**

**Further Evaluation**

- Holter / AECG
- Insertable loop recorder (ILR)
- Tilting-table test
- Electrophysiologic study (EPS)

**Carotid Sinus Massage**

- **Carotid Sinus Syndrome**
  - 3-sec pause and/or 50 mmHg fall in systolic blood pressure with (+) of symptoms
- **Contraindications**
  - carotid bruit / thrills, known significant carotid arterial disease, previous CVA, MI last 3 months
- **Risky** and Low Yield

**Test/Procedure Yield (based on mean time to diagnosis of 5.1 months)**

<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and Physical (including carotid sinus massage)</td>
<td>49-85%</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>40%</td>
</tr>
<tr>
<td>Tilt Table Test (without SHD)</td>
<td>11-87%</td>
</tr>
<tr>
<td>24-hour Holter/External Loop Recorder</td>
<td>2-20%</td>
</tr>
<tr>
<td>24-hour Insertable Loop Recorder</td>
<td>65-85%</td>
</tr>
<tr>
<td>Neuroradiology (Head CT Scan, Carotid Doppler)</td>
<td>0-4%</td>
</tr>
</tbody>
</table>

**Unexplained Syncope Algorithm**

- **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
- **Endocrine Evaluation**
- **Other CV Testing**
  - Angiogram
  - Exercise Test
  - SAECG
- **Psychological Evaluation**

Cardiac Syncope vs. Sudden Cardiac Death

- 80-90% of SCD are due to ventricular arrhythmias.
- 85-90% are due to 1st event, 10-15% due to recurrent events.

**Risk Stratification**

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Cardiac Syncope or Aborted SCD</th>
</tr>
</thead>
</table>

Typical Cardiac Syncope Algorithm

**History and Physical, ECG**

- Known SHD
  - No SHD
    - History and Physical, ECG
    - Syncope
    - No events in the past 12 months
    - > 2 Events
      - EPS
      - ILR
      - Tilt
    - < 30 days
    - Tilt/ILR
    - Treat
  - SHD
    - Known SHD
    - Echo
    - EPS
    - ILR
    - Tilt
    - Holter/ELR

**Risk Stratification**

Hazard Ratio for the Outcomes of Interest

<table>
<thead>
<tr>
<th>Cause of Syncope</th>
<th>Hazard Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any cause</td>
<td>1.23 (1.20-1.26)</td>
</tr>
<tr>
<td>Death from any cause</td>
<td>1.21 (1.19-1.22)</td>
</tr>
<tr>
<td>Malignant arrhythmia or death from coronary heart disease</td>
<td>1.22 (1.19-1.25)</td>
</tr>
<tr>
<td>Tilt or cardiac arrest</td>
<td>1.29 (1.26-1.33)</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>1.50 (1.47-1.52)</td>
</tr>
<tr>
<td>Death from any cause</td>
<td>1.71 (1.68-1.74)</td>
</tr>
<tr>
<td>Malignant arrhythmia or death from coronary heart disease</td>
<td>1.73 (1.70-1.76)</td>
</tr>
<tr>
<td>Tilt or cardiac arrest</td>
<td>1.78 (1.75-1.80)</td>
</tr>
<tr>
<td>Unrelated deaths</td>
<td>1.76 (1.73-1.79)</td>
</tr>
</tbody>
</table>

**San Francisco Syncope Rule**

- CHESS
  - Congestive Heart Failure History
  - Hematocrit < 30%
  - ECG abnormality
  - Short of Breath History
  - Systolic BP < 90 mmHg at Triage

- 74-98% sensitivity and 56-62% specificity for serious outcome
  - death, myocardial infarction, arrhythmia, pulmonary embolism, stroke, subarachnoid hemorrhage, significant hemorrhage, or any condition causing a return ED visit and hospitalization for a related event

**Risk Stratification**

Risk of SCD in Cardiac Syncope

- Individual
  - Depend upon underlying cardiac conditions
  - E.g.: Aortic stenosis: 3-year survival

- Overall
  - Depend upon prevalence of individual cardiac syncope AND
  - Overall performance of EP / Cardiologist / Others

**ELSE Study: Our Series**

- ED Life-threatening Syncope Evaluation study
  - 523 cases of true syncope in a 5-year retrospective analysis
  - 70% malignant arrhythmia
  - 10% CHF or LVEF <35%
  - 5% significant structural heart diseases
  - 15% combined

**Risk Stratification**

Cumulative incidence = 1 - e^{-\lambda t}

**ELSE Study**

- **ED Life-threatening Syncope Evaluation study**
  - 98% abnormal ECG
  - 56% high-risk ECG
  - Evidence of AMI, structural abnormality or substrate of malignant arrhythmia
  - 38% abnormal echocardiography
  - 15% recurrence

- **Overall 5-year survival: 48%**

- **Recurrence: 32% 5-year survival**

**ELSE Study: CLEARS**

- **For True Syncope**
  - Conscious change for more than 3 minutes
  - LVEF<35% / CHF
  - ECG suggesting cardiac arrhythmia or structural abnormality
  - Adam-Stokes attack
  - Recurrence within 6 hours
  - Shock (Hypotension without Orthostatic Changes)
  - Any one suggests admission; two or more (except recurrence within 6h) suggest significant mortality

**Clinical Significance**

- **Frequency**
  - Individuals <18 yrs: 15%
  - Individuals 40-59 yrs*: 16-19 %
  - Military Population 17- 46 yrs: 20-25 %
  - Individuals >70 yrs*: 23%

- **Conventional AECG**
  - Low Yield, Poor Symptom / Arrhythmia Concordance*
  - 8 studies, 2612 patients
  - 19% pts had symptoms with AECG
  - Only 4% had arrhythmia with symptoms
  - 79% pts were without symptoms
  - 14% had arrhythmia despite absence of symptoms

* During a 10-year period

**Ambulatory ECG**

<table>
<thead>
<tr>
<th>Method</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holter (24-48 hours)</td>
<td>Useful for infrequent events</td>
</tr>
<tr>
<td>Event Recorder</td>
<td>Useful for infrequent events, Limited value in sudden LOC</td>
</tr>
<tr>
<td>Loop Recorder</td>
<td>Useful for infrequent events, Implantable type more convenient (ILR)</td>
</tr>
<tr>
<td>Wireless (internet) Event Monitoring</td>
<td>In development</td>
</tr>
</tbody>
</table>

**Head-up Tilt Test (HUT)**

- Unmasks VVS susceptibility
- Reproduces symptoms
- Patient learns VVS warning symptoms
- Physician is better able to give prognostic / treatment advice

**Electroencephalogram**

- Not a first line of testing
- Syncope from Seizures
- Abnormal in the interval between two attacks – Epilepsy
- Normal – Syncope

**Value of Event Recorder in Syncope**

Asterisk denotes event marker

**Reveal® Plus Insertable Loop Recorder**

- Patient Activator
- Reveal® Plus ILR
- 9790 Programmer
ILR Recordings

56 yo woman with syncope accompanied with seizures.
Infra-Hisian AV Block: Dual chamber pacemaker

56 yo man with syncope accompanied with brief retrograde amnesia.
VT and VF: ICD and meds

*Medtronic data on file