Syncope: Definition

Temporary interruption of cerebral perfusion manifested by loss of consciousness with spontaneous recovery.
“Those who suffer from frequent and severe fainting often die suddenly.”

*Hippocrates, 1000 BC*

**Significance**

**General population**
- 3% of all ER visits
- 2-6% of hospital admissions (160,000 hospitalizations/yr)
- 1.5 million physician visits/yr

Kapoor: JAGS, 1994; HCFA, 1996
Syncope in Elderly

Elderly population
- 80% of ER and hospital pts for syncope evaluation >65 yr
- 6% annual incidence of syncope among institutionalized elderly
- 30% institutionalized elderly with syncope have recurrences


“Honey, are you going to faint again tonight?”

Economic Burden of Syncope Evaluation
- Up to $17,000/pt of “unnecessary” testing for diagnosis of vasovagal syncope ($25,116 adjusted) (Calkins, 1993)
- Overall cost per admission $5,300 ($6,764 adjusted) (HCFA, 1996)
- Cost to health care system >2 billion per year (Olshansky, 1998)
Syncope at Mayo Medical Center

- 1000 ER patients/year
- 2,500 outpatient clinical evaluations/year
- 400 hospital admissions/year
- 30% of the total electrophysiology practice
  - 500 arrhythmia consults/year
  - 250 EP studies/year
  - 300 tilt table tests/year

Syncope

Causes

- Cardiac
- Noncardiac
Syncope: High vs. Low Risk

**High Risk**
- CAD, previous MI
- CHF
- Age >65
- Abrupt onset (celery syncope)
- Associated injury
- Abnormal ECG, SAECG
- LVEF <40%

**Low Risk**
- Isolated episodes without CV diseases
- Age <65
- Symptoms consistent with vasovagal syncope (spaghetti syncope)
- Normal ECG
- Normal EF

Syncope — Distribution by Causes

**Younger Adults**
- OH, situational seizures, drugs: 30%
- 1° arrhythmia Cardiogenic: 40%
- Other causes: 15%

**Elderly**
- OH, CSS, situational seizures, drugs: 30%
- 1° arrhythmia Cardiogenic: 25%
- Other causes: 15%

**Cardiogenic**
**Vasovagal**
**Undetermined**
**Other causes**

Syncope

- Causes range from simple faint to severe life threatening cardiac arrhythmias.
- Prognosis depends upon underlying organic disease processes and the association of trauma.
Syncope
Natural History

Syncope: Key Features

- Prodromal symptoms (nausea, diaphoresis, palpitations)
- Abruptness of onset, offset (spaghetti vs. celery syncope).
- Associated symptoms (seizure activity, incontinence, confusion)
Syncope

Evaluation

Discord in the Evaluation of Syncope

Neurologist  Cardiologist

Syncope: Diagnosis By History

The diagnostic yield from the initial history and physical examination along with an ECG ranges from 40-75%
Syncope Evaluation

History

Syncope Evaluation

Pertinent History

- Obvious precipitant?
  - Physical, emotional distress, posture, meal, neck turning
- Premonitory symptoms?
  - Cardiogenic vs reflexogenic vs neurogenic
- Drugs and time of administration
  - Negative chronotropic, dromotropic agents, vasodilators, over-counter
- Duration of symptoms/recovery
- Risk factors for cardiogenic syncope
  - Coexisting medical illnesses, prior history of cardiac disease

Syncope Evaluation

History

Medical and neurologic exam
Syncope Evaluation

Physical examination
- Orthostatic BP checks (before and after meals)
- Cardiac exam
  - Arrhythmias
  - Valvular disease
  - Compromised cardiac function
- Carotid auscultation
- Carotid sinus massage

“Low” risk for cardiogenic syncope
- Tilt table testing
- Ambulatory BP and/or ECG monitoring
- Neurologic testing
- Endocrinologic testing

Proposed Risk Factors Associated with Cardiogenic Syncope

High Risk Factors
History and physical exam
- Coronary artery disease, prior myocardial infarction
- Congestive heart failure
- Older age
- Abrupt onset
- Serious injuries
- Abnormal signal-averaged electrocardiogram

Laboratory findings
- Abnormal electrocardiogram
  - Presence of Q-wave, bundle-branch block, or sinus bradycardia
- Structural heart disease
- Left ventricular dysfunction
“High” risk for cardiogenic syncope
Electrophysiologic testing

Non-diagnostic and events are infrequent
Consider an event recorder

- Carotid ultrasound
- CT scan
- MRI
- EEG
- Transcranial Doppler
- Metabolic testing
Diagnostic Efficacy of 24 Hour Holter Monitoring for Syncope

1,512 patients
- Syncope/presyncope during monitoring (17%)
- Arrhythmia without symptoms (15%)
- Documented arrhythmia (2.1%)

Gibson: AJC 53, 1984

Tilt Table Testing

Passive Tilt Table Testing
Duration and Positive Yield

- 10-60 min have been advocated
- Fitzpatrick (1991): 60°, n=71
  Time to symptoms=24±10 min
- Shen (1997): 70°, n=111
  Time to symptoms=19±11 min
- Most clinical investigators favor a 45 min tilt
Passive Tilt Table Testing

| Tilt angle     | 60-80° acceptable  
|               | 70° most common    |
|               | Tilt duration 30-45 min  
|               | Data support a 45 min protocol |

Goals for Additional Provocative Tilt Table Testing in Clinical Practice

- Increase diagnostic yield
- Shorten procedural time
- Reproduce symptoms
- Not compromise sensitivity and specificity

Tilt Table Testing

| Pharmacologic provocation | Isoproterenol  
|                          | Adenosine  
|                          | Nitroglycerin  
|                          | Edrophonium |

Comments

A single-stage isoproterenol testing reasonable (60-70°, 10 min, low to intermediate dose ≤0.05 mcg/kg/min)
Higher positive yield, shorter procedural time at the expense of decreased specificity
Consideration of Tilt Table Testing
Clinical Presentation Suggestive of Vasovagal Syncope

<table>
<thead>
<tr>
<th>&quot;Indication&quot; for tilt table testing</th>
<th>Typical</th>
<th>Atypical (undetermined)</th>
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</thead>
<tbody>
<tr>
<td>Recurrent/trauma</td>
<td></td>
<td></td>
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<tr>
<td>Mechanisms</td>
<td></td>
<td>&quot;Exclusion&quot; of the Dx needed for Pt management</td>
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<tr>
<td>Guiding therapy (?)</td>
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<td></td>
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<tr>
<td>Reassurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tilt table method</td>
<td>Adequate “sensitivity”</td>
<td>High specificity</td>
</tr>
</tbody>
</table>

Tilt Table Testing: Mayo Protocol

Testing guided by patient’s history

- All patients have CSM unless contraindicated
- Isoproterenol tilt only if history consistent with vasovagal (.05 mcg/kg/min, five minutes supine, 10 minutes upright)
- 45 minute tilt otherwise

Carotid Sinus Hypersensitivity

- Pause >3 sec
- Decrease SBP >30 mm Hg
- Correlation to symptoms

![Carotid Sinus Hypersensitivity Diagram]
Carotid Sinus Hypersensitivity and Carotid Sinus Syndrome

- 10% of elderly has carotid sinus hypersensitivity (very rough estimation)
- 5-20% of CSH develop carotid sinus symptoms
- Over- or under-diagnose carotid sinus syndrome?

Katritis: PACE, 1991; McIntosh: Age and Aging, 1993; Dey: PACE, 1997; Forman: Card Clin, 1997; Strasberg: Prog CVD, 1999

Vasovagal Reflex Physiology

Baseline BP 136/67 mmHg
HR = 115 bpm

Baseline Tilt
Vasovagal response

BP 54/30 mmHg
HR = 39 bpm
PCL = 700 msec

A-V pacing CI = 700 ms

Syncope

Treatment / New Investigations
Implantable Loop Recorder

**Four Programmable Storage Modes**

<table>
<thead>
<tr>
<th>Total storage time</th>
<th>Time stored before and after activation (•)</th>
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<tbody>
<tr>
<td>21 min</td>
<td>20 min • 1 min</td>
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<tr>
<td>21 min</td>
<td>20 min • 1 min</td>
</tr>
<tr>
<td>42 min*</td>
<td>40 min • 2 min</td>
</tr>
<tr>
<td>42 min*</td>
<td>12 min • 2 min</td>
</tr>
</tbody>
</table>

*42-min modes use data compression to increase storage
*Autoactivation: low rate, high rate, and self activation
### Implantable Recorder

- Diagnostic yield: 64% with 6 month minimum follow-up
- ILR is effective long-term monitor to help diagnose unexplained syncope patients in selected patients

*Crahn, Circ. 1999; 100:I-20.*

### Analysis Of 206 Syncope Patients

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Arrhythmic</td>
<td>47 (23%)</td>
<td></td>
</tr>
<tr>
<td>Vasovagal</td>
<td>21 (10%)</td>
<td></td>
</tr>
<tr>
<td>NSR</td>
<td>64 (31%)</td>
<td></td>
</tr>
<tr>
<td>Non-Compliant</td>
<td>9 (4%)</td>
<td></td>
</tr>
<tr>
<td>No Event</td>
<td>65 (32%)</td>
<td></td>
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</tbody>
</table>

Rhythm strip useful in diagnosis of 132 patients (64%).

### Syncope Time to First Recurrence

- Cumulative risk (%)
- No pacemaker
- Pacemaker

<table>
<thead>
<tr>
<th>Risk (no.)</th>
<th>Months</th>
<th>Cumulative risk (%)</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>27</td>
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<td>100</td>
</tr>
<tr>
<td>P</td>
<td>27</td>
<td>0</td>
</tr>
</tbody>
</table>

VPS: JACC, 1999

2P=0.00022
38 year old male admitted for recurrent syncope. Labs, 12 lead ECG, echo normal. This is patients 15th episode. Prodrome of lightheadedness, diaphoresis. No history of injury. Previous workups have been non-diagnostic.

What next?
- Event recorder?
- Implantable loop recorder?
- Tilt table study?
- Catheter study?
- Neurologic evaluation?
Syncope: Case #1

Performed tilt table study. At 10 minutes upright, patient experienced syncope with 30 seconds of asystole. What now?

• Pacemaker?
• Beta blocker?
• EPS?

Treated patient with Lopressor 50 mg BID. No further syncope in five year F/U

Syncope: Case #2

67 year old female with syncope x2. No prodrome. Out for approximately 30 seconds. No ill effects post event. History includes CAD, LVEF 40%, and is S/P stenting of a 95% LAD, RCA is occluded. No other critical lesions. On Lopressor and Ace inhibitor.
Syncope: Case #2

Testing
- CBC, electrolytes, CK/MB WNL
- ECG: Q-waves in II, III, AVF consistent with old IWMI. No other abnormalities

What should be done next?
- Angiogram?
- EPS?
- Event recorder?
- Stress test?

EPS Performed
- Sinus node: CSNRT 850 msec
- AVN: Atrial decremental pacing 1:1 at 400, Wenkebach at 380
- MMVT, CL 600, with double stimuli at apex (400/260/240). Burst terminated. SBP 105 during VT.
- CSM: 8.8 second pause with syncope. Correlated with symptoms.
Syncope: Case #2

What next?

- PPM?
- Dual chamber ICD?
- VT ablation?

Syncope: Case #3

27 year old female (former pageant contestant) with nine month history of syncope. Three of the episodes required hospitalizations with dopamine blood pressure support. During these hospitalizations no arrhythmias were observed. First seen at Mayo in the clinic setting, later admitted to the CCU after severe hypotension in the ER.

Outside testing / Mayo findings

- Normal ECG, monitoring
- SBP <70 without dopamine
- CBC, electrolytes, CK/MB’s, WNL
- Neurological examination intact
- Normal echo
- Normal stress test
Syncope: Case #3

Now hospitalized. EP consult requested. What next?
- EPS
- Tilt table testing
- More labs
- Angiogram

Syncope: Case #3

Drug screen obtained, patient found to have ingested a large quantity of verapamil (took grandmothers prescription. Psychology examination obtained. Patient treated for depression.

Deep Thoughts......
- If a person owns a piece of land, do they own it to the core of the earth?
- Why can’t woman put on mascara with their mouth closed?
- Is it possible to brush your teeth without wiggling your butt?
- Why are they called stairs inside but steps outside?
- Why is there a light in the fridge but not in the freezer?
- If croutons are stale bread, why do they come in airtight packages?
Deep Thoughts, cont…..

- Why does mineral water that has trickled through the mountains for centuries have a 'use by' date?
- Why does a toaster always have a setting that burns toast to a horrible crisp that no-one would eat?
- Can you sentence a homeless man to house arrest?
- Who was the first person to look at a cow and say, 'I think I'll squeeze on those dangly things here and drink whatever comes out'?
- If the professor on Gilligan's Island can make a radio out of a coconut, why can't he fix a hole in the boat?
- Is French kissing in France just kissing?