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Medtronics
• Palpitations
• Palpitations & CP
• CP
• Palp. CP and Syncope
• CP & Syncope
Palpitations

- Heart flip-flopping
- Heart fluttering
- Skipping beats
- Pounding esp. while lying on left-side
- Sensation of pulsation in neck
Patient History

- Hypertension
- Thyroid Disease
- Electrolyte Disorder
- Neuropsychiatric disorder
- Sarcoidosis, Amyloidosis
Cardiovascular History

- Ischemic Heart Disease
- Valvular Heart Disease
- Preexcitation/WPW
- Long-QT Syndrome
- Rheumatic heart disease
- Heart Failure/cardiomypathy
Social History

- ETOH
- Caffeine
- Tobacco
- Illicit drug
- Stress
Family History

• CV disease
• Sudden Cardiac death
• Arrhythmias
<table>
<thead>
<tr>
<th>Type</th>
<th>Example Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>α-Adrenergic agonist</td>
<td>Phenylpropanolamine, Phenylephrine</td>
</tr>
<tr>
<td>β-Adrenergic agonist</td>
<td>Terbutaline, Isoproterenol, Albuterol</td>
</tr>
<tr>
<td>Methylxanthine</td>
<td>Theophylline</td>
</tr>
<tr>
<td>Psychoactive</td>
<td>Phenothiazines, Tricyclics</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Thyroxine</td>
</tr>
<tr>
<td>Anticholinesterase</td>
<td>Physostigmine, Neostigmine</td>
</tr>
<tr>
<td>Antimuscarinic</td>
<td>Atropine, Scopolamine</td>
</tr>
<tr>
<td>Illicit</td>
<td>Amphetamine, Cocaine</td>
</tr>
</tbody>
</table>

*Partial listing of more commonly associated drugs.
Risk Stratification
Low Risk

- No Structural Heart Disease
- No history of near-syncope or syncope
- No evidence of myocardial ischemia
- Preserved left ventricular function
Risk Stratification
High Risk

- Structural Heart Disease
- History of syncope
- Left ventricular ejection fraction < 40% or symptomatic heart failure
- CAD
- Conduction system disease
- Long-QT syndrome
- WPW syndrome
<table>
<thead>
<tr>
<th>Table 6  Evaluation of arrhythmias in patients with palpitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign arrhythmias that generally do not require extensive evaluation</td>
</tr>
<tr>
<td>Sinus bradycardia</td>
</tr>
<tr>
<td>Sinus arrhythmia</td>
</tr>
<tr>
<td>Isolated atrial premature beats</td>
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<tr>
<td>Isolated ventricular premature beats</td>
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<tr>
<td>Arrhythmias that may require more extensive evaluation</td>
</tr>
<tr>
<td>Tachy-brady syndrome</td>
</tr>
<tr>
<td>Atrioventricular nodal reentrant tachycardias</td>
</tr>
<tr>
<td>Atrioventricular reciprocating tachycardias</td>
</tr>
<tr>
<td>Nonsustained ventricular tachycardia</td>
</tr>
<tr>
<td>Prognostically important ventricular premature beats (couplets, triplets, multiform, R-on-T beats, very frequent beats)</td>
</tr>
<tr>
<td>Arrhythmias that generally require further evaluation</td>
</tr>
<tr>
<td>Persistent atrial or sinus tachycardia</td>
</tr>
<tr>
<td>Preexcitation/Wolff-Parkinson-White syndrome</td>
</tr>
<tr>
<td>Atrial fibrillation/atrial flutter</td>
</tr>
<tr>
<td>Sustained ventricular tachycardia</td>
</tr>
</tbody>
</table>
Evaluation of Arrhythmias

• Benign
  – Sinus Bradycardia
  – Sinus Arrhythmia
  – Isolated atrial premature beats
  – Isolated ventricular premature beats
Evaluation of Arrhythmias

- Arrhythmias that *may* require more extensive evaluation:
  - Tachy-brady syn.
  - AVNRT
  - AV reciprocating tachycardias
  - Nonsustained VT
  - PVCs: couplets, R-on-T, triplets, multiform
Evaluation of Arrhythmias

• Arrhythmias requiring evaluation:
  – Persistent atrial or sinus tachycardia.
  – Preexcitation/WPW
  – Atrial fibrillation/atrial flutter
  – Sustained VT
What to do with Palpitations?

• Rule-in Low risk
• Rule-out High Risk
Transient Loss of Consciousness (TLOC)
Classification of Transient Loss of Consciousness (TLOC)

Real or Apparent TLOC

Syncope
• Neurally-mediated reflex syndromes
• Orthostatic hypotension
• Cardiac arrhythmias
• Structural cardiovascular disease

Disorders Mimicking Syncope
• With loss of consciousness, i.e., seizure disorders, concussion
• Without loss of consciousness, i.e., psychogenic “pseudo-syncope”

Syncope – A Symptom, Not a Diagnosis

- Self-limited loss of consciousness and postural tone
- Relatively rapid onset
- Variable warning symptoms
- Spontaneous, complete, and usually prompt recovery without medical or surgical intervention

Underlying mechanism is transient global cerebral hypoperfusion.

Causes of True Syncope

Neurally-Mediated
- VVS
- CSS
- Situational
  - Cough
  - Post-Micturition

Orthostatic
- Drug-Induced
- ANS Failure
  - Primary
  - Secondary

Cardiac Arrhythmia
- Brady
  - SN Dysfunction
  - AV Block
- Tachy
  - VT
  - SVT
- Long QT Syndrome

Structural Cardio-Pulmonary
- Acute Myocardial Ischemia
- Aortic Stenosis
- HCM
- Pulmonary Hypertension
- Aortic Dissection

Unexplained Causes = Approximately 1/3

DG Benditt, MD. U of M Cardiac Arrhythmia Center
## Causes of Syncope by Age

### Younger Patient
- **Vasovagal**
- **Situational**
- **Psychiatric**
- Long QT*
- Brugada syndrome*
- WPW syndrome*
- RV dysplasia*
- Hypertrophic cardiomyopathy*
- Catecholaminergic VT
- Other genetic syndromes

### Older Patient
- **Cardiac****
  - Mechanical
  - Arrhythmic
- **Orthostatic hypotension**
- **Drug-induced**
- Neurally mediated
- **Multifactorial**

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*Underlined: benign
*Rare, not benign
**Not benign

Syncope Mimics

- Acute intoxication (e.g., alcohol)
- Seizures
- Sleep disorders
- Somatization disorder (psychogenic pseudo-syncope)
- Trauma/concussion
- Hypoglycemia
- Hyperventilation

Impact of Syncope: Costs

- Estimated hospital costs exceeded $10 billion US\(^1\)
- Estimated physician office expenses exceeded $470 million\(^2\)
- £104,285 spent on 1,334 patients with syncopal codes (UK) (EaSyAS)\(^3\)
  - Hospital admission: 67% of investigational costs
- Over $7 billion is spent annually in the US to treat falls in older adults\(^4\)

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\(^2\)OutPatientView v. 6.0. Solucient LLC, Evanston IL.
Challenges of Syncope

- Diagnosis
  - Complex

- Quality of life implications
  - Work
  - Mobility (automobiles)
  - Psychological

- Cost
  - Cost/year
  - Cost/diagnosis
A Diagnostic Plan is Essential

- **Initial Examination**
  - Detailed patient history
  - Physical exam
  - ECG
  - Supine and upright blood pressure

- **Monitoring**
  - Holter
  - Event
  - Insertable Loop Recorder (ILR)

- **Cardiac Imaging**

- **Special Investigations**
  - Head-up tilt test
  - Hemodynamics
  - Electrophysiology study

Initial Exam: Detailed Patient History

- Circumstances of recent event
  - Eyewitness account of event
  - Symptoms at onset of event
  - Sequelae
  - Medications

- Circumstances of more remote events

- Concomitant disease, especially cardiac

- Pertinent family history
  - Cardiac disease
  - Sudden death
  - Metabolic disorders

- Past medical history
  - Neurological history
  - Syncope

Initial Exam: Thorough Physical

- Vital signs
  - Heart rate
  - Orthostatic blood pressure change

- Cardiovascular exam: Is heart disease present?
  - ECG: Long QT, pre-excitation, conduction system disease
  - Echo: LV function, valve status, HCM

- Neurological exam

- Carotid sinus massage
  - Perform under clinically appropriate conditions preferably during head-up tilt test
  - Monitor both ECG and BP

Carotid Sinus Massage (CSM)

■ Method\(^1\)
  - Massage, 5-10 seconds
  - Don’t occlude
  - Supine and upright posture (on tilt table)

■ Outcome
  - 3 second asystole and/or 50 mmHg fall in systolic BP with reproduction of symptoms = Carotid Sinus Syndrome

■ Absolute contraindications\(^2\)
  - Carotid bruit, known significant carotid arterial disease, previous CVA, MI last 3 months

■ Complications
  - Primarily neurological
  - Less than 0.2\(^{\%}\)\(^3\)
  - Usually transient

\(^1\)Kenny RA. Heart. 2000;83:564.
Other Diagnostic Tests

- Ambulatory ECG
  - Holter monitoring
  - Event recorder
    - Intermittent vs. Loop
    - Insertable Loop Recorder (ILR)
- Head-Up Tilt (HUT)
  - Includes drug provocation (NTG, isoproterenol)
  - Carotid Sinus Massage (CSM)
- Adenosine Triphosphate Test (ATP)
- Electrophysiology Study (EPS)

Heart Monitoring Options

- **12-Lead**
  - Time: 10 Seconds

- **Holter Monitor**
  - Time: 2 Days

- **Event Recorders (non-lead and loop)**
  - Time: 7-30 Days

- **ILR**
  - Time: Up to 14 Months

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## Diagnostic Assessment: Yields
\( (N=341^1 \text{ to } 433^2) \)

<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Evaluation</strong></td>
<td></td>
</tr>
<tr>
<td>History, Physical Exam, ECG, Cardiac Massage</td>
<td>38-40</td>
</tr>
<tr>
<td><strong>Other Tests/Procedures</strong></td>
<td></td>
</tr>
<tr>
<td>Head-Up Tilt</td>
<td>27</td>
</tr>
<tr>
<td>External Cardiac Monitoring</td>
<td>5-13</td>
</tr>
<tr>
<td>Insertable Loop Recorder (ILR)</td>
<td>43-883-5</td>
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<tr>
<td>EP Study</td>
<td>&lt;2-5</td>
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<tr>
<td>Exercise Test</td>
<td>0.5</td>
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<tr>
<td>EEG</td>
<td>0.3-0.5</td>
</tr>
<tr>
<td>MRI</td>
<td>No data available(^6)</td>
</tr>
</tbody>
</table>
Neurological Tests: Rarely Diagnostic for Syncope

- EEG, Head CT, Head MRI
- May help diagnose seizure

Head-Up Tilt Test (HUT)

- Protocols vary
- Useful as diagnostic adjunct in atypical syncope cases
- Useful in teaching patients to recognize prodromal symptoms
- Not useful in assessing treatment

Head-Up Tilt Test: ECG Leads and Intra-Arterial Pressure Tracing

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Adenosine Triphosphate (ATP) Test

- Ongoing investigation in the US
- Provokes a short and potent cardioinhibitory vasovagal response
- Advantages
  - Simple
  - Inexpensive
  - Correlation with pacing benefit
- Seems to identify a unique mechanism of syncope found in patients with:
  - Advanced age
  - More hypertension
  - More ECG abnormalities

Donateo P. *J Am Coll Cardiol*. 2003;41:93-98.
Insertable Loop Recorder (ILR)

Reveal® Plus ILR

Typical Location of the Reveal® Plus ILR

Click once on black screen to play video.
Insertable Loop Recorder (ILR)

The ILR is an implantable patient – and automatically – activated monitoring system that records subcutaneous ECG and is indicated for:

- Patients with clinical syndromes or situations at increased risk of cardiac arrhythmias
- Patients who experience transient symptoms that may suggest a cardiac arrhythmia
Conventional EP Testing in Syncope

- Greater diagnostic value in older patients or those with SHD
- Less diagnostic value in healthy patients without SHD

Useful diagnostic observations:

- Inducible monomorphic VT
- SNRT > 3000 ms or CSNRT > 600 ms
- Inducible SVT with hypotension
- HV interval ≥ 100 ms (especially in absence of inducible VT)
- Pacing induced infra-nodal block

Diagnostic Limitations of EPS

- Difficult to correlate spontaneous events and laboratory findings

- Positive findings\(^1\)
  - Without SHD: 6-17%
  - With SHD: 25-71%

- Less effective in assessing bradyarrhythmias than tachyarrhythmias\(^2\)

- EPS findings must be consistent with clinical history
  - Beware of false positive

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Specific Conditions

- Cardiac arrhythmia
  - Brady/Tachy
  - Long QT syndrome
  - Torsade de pointes
  - Brugada
  - Drug-induced

- Structural cardio-pulmonary

- Neurally-mediated
  - Vasovagal Syncope (VVS)
  - Carotid Sinus Syndrome (CSS)

- Orthostatic