The San Francisco Syncope Rule to Predict Patients with Serious Outcomes

Daniel McDermott, MD
Associate Clinical Professor
Department of Emergency Medicine
University of California, San Francisco

An Interesting Presentation

• 62 yo MD/PhD presents with abnormal pre-stress EKG
• He had been having atypical chest pain for one week. Seen by PMD the day prior
• CAD RF-High Cholesterol
• Medications-Lipitor, ASA, started Atenolol
• Clinically asymptomatic today
• Prior history of syncope in past

An Interesting Presentation

• EKG in PMD’s Office

An Interesting Presentation

• EKG prior to cardiac stress testing
And Then……

Patient went to immediate cardiac cath
Had a stenotic LAD lesion-stented
Referred to as Wellen’s Syndrome
Then, had second episode of asystole
Refused pacemaker placement
Signed out AMA

An Interesting Presentation

• Patient went to immediate cardiac cath
• Had a stenotic LAD lesion-stented
• Referred to as Wellen’s Syndrome
• Then, had second episode of asystole
• Refused pacemaker placement
• Signed out AMA

Syncope

• Originates from the Greek word of *synkoptein* translating “to cut short”
• Syncope is a symptom, not a diagnosis
• Transient loss of consciousness with return to baseline neurologic function
• Hypoperfusion to the cerebral cortex and RAS for 8-10 seconds

Causes of Syncope

• Neural mediated
• Orthostasis
• Cardiac
• Neurologic
• Medication related
**Causes-Neurally Mediated**

- Vasovagal
  - Associated with sense of warmth and/or nausea
  - Often associated with unexpected stimulus
  - Can be associated with prolonged standing
- Situational
  - Cough, defecation, micturition, swallowing
- Carotid sinus syncope
  - Associated with neck pressure or head turning

**Causes-Orthostasis**

- A drop in blood pressure associated with symptoms
- Is considered positive if the systolic blood pressure drops more than 20 mmHg or the blood pressure is below 90 mmHg regardless of symptoms
- Should be taken after the patient is supine for 5 minutes and taken at 1 and 3 minutes after standing
- Could also be secondary to acute blood loss

**Causes-Neurologic**

- Could include TIA, seizure, migraine headache or subclavian steal syndrome
- Not uncommon to have brief convulsive activity if the brain is hypo-perfused
- Confusion after the event for longer than 5 minutes suggests seizure
- Tongue biting, aura and incontinence also suggest seizure

An example of syncope related to swallowing
Causes-Cardiac Related

• Arrhythmia
  – Both tachy and brady arrhythmias
    • Look for Wellen’s, Brugada, sinus pauses, interval variants such as prolonged QT and short PR
    – Difficult to identify, even with rigorous testing
• Ischemia
• Valvular

Causes-Medication Related

• Medication related-prone to arrhythmia
  – Anti-arrhythmics
  – Anti-anginal medications
  – Anti-hypertensive medications
  – Diuretics
  – Medications prolonging the QT interval

Brugada Syndrome

Physical Exam Findings

• Vital signs
  – Orthostatic vitals can be helpful, also an O2 saturation
• Cardiovascular exam
  – Carotid exam/JVP
  – Murmurs
  – Rhythm
• Neurologic exam
  – Tongue biting, post-ictal phase suggests seizure
• Focused exam based on history
  – Look for GI bleed, AAA, Ectopic, Pulmonary Embolus
ED Work-up

- EKG
- Consider glucose, hemoglobin
- Urine pregnancy test
- Echo often helpful for admitted patients

Background

- 1 in 4 people will faint during their lifetime
- It is estimated that 1-3% of all ED visits are prompted by transient loss of consciousness
- 1-6% of hospital admissions are patients presenting with syncope
- 1 million people seek care each year for syncope at a cost of over 1 billion dollars

Background

- Prior studies have focused on identifying patients with cardiac syncope because “Patients with cardiovascular causes have a strikingly higher incidence of sudden death than patients with a noncardiovascular or unknown cause.” Kapoor, NEJM, 1983.
- The incidence of cardiac syncope is thought to be between 6-15%.
- There are also other serious causes of syncope.

Background

- Patients presenting with cardiac syncope are considered to be high risk for significant morbidity and mortality at one year. Martin, Kapoor, AEM, 1997
- Etiologic causes include arrhythmia, ischemia and structural abnormalities
- Syncope itself is not a risk for mortality at one year, but underlying cardiovascular disease is. Kapoor, Hanusa, AMJ, 1996
Background

• Syncopal patients can be a difficult disposition decision
  – Up to 50% can be accurately diagnosed based on history, physical exam and EKG
  – However, for patients with unexplained syncope, it is often difficult to elucidate the cause, and 30-45% of patients will remain undiagnosed

Prior Studies-Martin

• Multivariate predictors of 1 year outcomes for arrhythmia or mortality were as follows:
  – Abnormal EKG
  – History of Ventricular Arrhythmia
  – History of CHF
  – Age >45
• Prospectively done
• Emergency Medicine based
  Martin, Kapoor, AEM, 1997

Prior Studies-Colivicchi

• OESIL Risk Score with Prospective Validation-
  Multivariate predictors of 1 year mortality included:
  – Age >65 years
  – History of cardiovascular disease
  – Syncope without prodrome
  – An abnormal EKG
• Italian based study
  Colivicchi et al., European Heart Journal, 2003

Background

• A survey of physicians evaluating patients with syncope was the 2nd most important clinical decision problem for North American physicians and the 3rd most important for European physicians. Graham I, Stiell IG, et al 1999
• Emergency physicians can accurately identify patients at risk for a serious outcome but still admit many patients with benign causes.
**Prior Studies-Sarasin**

- Recent publication for Risk Score to Predict Arrhythmia in Unexplained Syncope
- Derivation cohort with cross validation
- Predictors of Arrhythmia were as follows:
  - Abnormal EKG
  - History of CHF
  - Age>65
- Methodologically flawed
  
  *Sarasin, Kapoor, Academic Emergency Medicine, 2003*

**Current ACEP Recommendations**

- History and Physical Exam to risk stratify
  - Level A-Hx or PE consistent with CHF
  - Level B-Consider older age, structural heart disease, or CAD
  - Level B-Consider young patients with exertion, hx of sudden death
- Diagnostic tests to risk stratify
  - Level A-Obtain a 12 lead ECG
  - Level C-Other testing-lab, Echo, head CT generally not indicated without specific findings
- Who should be admitted for unclear cause
  - Level A-None
  - Level B-Admit with evidence of CHF or structural heart disease
  - Level B-Admit patients that are high risk
  - Older age, abnormal ECG, HCT<30, CHF, CAD or Structural

  *Clinical Policy, Annals of Emergency Medicine, April, 2007*

**Post micturition, vagal (fear), blood loss??**

**Derivation of the SFSR**

- Develop a clinical decision rules/guidelines to help identify patients with serious outcomes and help guide admission decisions
  - Multiple studies have addressed one year outcomes
  - Several studies have looked at risk stratification scores to predict high risk patients
  - No study has addressed short term outcomes….
Methods

- Over a 20-month period, emergency physicians at a university teaching hospital prospectively completed a structured data form when evaluating patients with syncope.
- The data form and clinical endpoints for the study were defined at the start of the study by a review of the literature and consensus of experts.
- Exclusion criteria were seizure, prolonged AMS, trauma related or if drugs/alcohol caused the event.

7 day follow up to determine serious outcomes
- Death
- Myocardial infarction, Arrhythmia
- Subarachnoid Hemorrhage, Stroke
- Significant hemorrhage requiring transfusion
- Pulmonary embolism
- Any related event within one week resulting in hospitalization
- F/U completed on all patients using a structured data form by reviewing inpatient charts, interviewing PMD, patients, family members and when necessary using death records and admission to local hospitals.

Results

- 684 visits for syncope
- 56% of patients required admission
- 79 visits resulted in patients developing serious outcomes
- 55 Cardiac events (21 MI, 29 Arrhythmias, 5 structural)
- 13 Significant hemorrhage-included AAA, ectopic
- 5 Pulmonary embolisms
- 4 CNS events (2 stroke syndromes, 2 SAH)
- 2 Other (sepsis, return visit)
The San Francisco Syncope Rule to Predict Patients with Serious Outcomes

Chf, Hct, Ekg, SBP, SOB

- Abnormal EKG
- Complaint of SOB
- HCT < 30
- SBP < 90
- History of CHF

Results
San Francisco Syncope Rule

1) Abnormal EKG, SOB, HCT<30, SBP <90, Hx of CHF
   - Sens 96.2% (95% CI 89% – 98%), Spec 62%
   - Admit 44 %, decrease admitted patients by 39%
2) Add AGE > 75
   - Sens 100% (95% CI 95% – 100%), Spec 44%
   - Admit 61%, decrease admitted patients by 18%

*Abnormal EKG = new changes and/or not sinus rhythm including ED monitoring
**HCT<30=acute bleeding episode requiring transfusion of PRBC’s

Discussion

- Retrospectively you can always get a rule that is 100% sensitive with decision analysis software.
  - The more nodes containing fewer cases makes it harder to validate rules prospectively with 100% sensitivity and a rule for syncope that is 100% sensitive is probably unrealistic and would not be sufficiently specific.
- A rule or test that risk stratifies with a 96% sensitivity and greater than 60% specific is still very useful, performing better than most lab and radiographic studies.

Conclusions

- The San Francisco Syncope Rule is highly sensitive and identifies patients at risk of a serious outcome by day 7.
- It appears to be a valuable tool in risk stratifying and guiding admission decisions.
- It will require prospective validation
Prospective Validation-SFSR

Validation of the SFSR

- Currently internally validated
  - 791 patients enrolled with 108 serious outcomes
- Sensitivity and specificity appear to be consistent with the derivation cohort
- Similar serious outcome rate and distribution

Results - Phase II – Validation

Sensitivity and Specificity of SFSR
For Predicting Unknown Serious Outcomes N=767

<table>
<thead>
<tr>
<th>Serious Outcome</th>
<th>SFSR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ ve</td>
</tr>
<tr>
<td>+ ve</td>
<td>52</td>
</tr>
<tr>
<td>- ve</td>
<td>1</td>
</tr>
</tbody>
</table>

Sensitivity 98% (95% CI 89% - 100%)  
Specificity 52% (95% CI 48% – 56%)  
LR + ve = 2.03 (95% CI 1.9 – 2.2)  
LR – ve = 0.04 (95% CI 0.01-0.25)

Discussion

- Validation cohort yielded similar results to the derivation cohort
- Patients with undiagnosed serious causes are of most importance for a prediction tool
- Rule may not predict rare serious outcomes
- Rule has the potential to decrease admissions by 10 - 12%
- Next phase - multi-center validation and implementation
### External Validation of SFSR

<table>
<thead>
<tr>
<th>Study</th>
<th>Admission Rate</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Strict Methods</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFSR Derivation (Quinn 2004)</td>
<td>55%</td>
<td>96%</td>
<td>62%</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>SFSR Validation (Quinn 2006)</td>
<td>59%</td>
<td>98%</td>
<td>56%</td>
<td>Yes</td>
<td>Same site</td>
</tr>
<tr>
<td>UCLA (Sun 2007)</td>
<td>58%</td>
<td>89%</td>
<td>42%</td>
<td>No</td>
<td>Different ECG criteria-retrospectively applied</td>
</tr>
<tr>
<td>Rose Pilot-UK (Reed 2007)</td>
<td>44%</td>
<td>100%</td>
<td>46%</td>
<td>Yes</td>
<td>Small prospective cohort</td>
</tr>
<tr>
<td>Australia (Cosgriff 2007)</td>
<td>36%</td>
<td>90%</td>
<td>57%</td>
<td>No</td>
<td>Retrospective</td>
</tr>
<tr>
<td>New York (Birnbaum, 2008)</td>
<td>86%</td>
<td>74%</td>
<td>57%</td>
<td>No</td>
<td>Inclusion bias</td>
</tr>
<tr>
<td>Canada (Venk 2010)</td>
<td>12%</td>
<td>9096%</td>
<td>33%</td>
<td>No</td>
<td>Retrospective</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Monitor changed sensitivity</td>
</tr>
</tbody>
</table>

### Syncope and ECG

- A subset study of the derivation cohort presented
- The electrocardiogram is the most important risk stratifying tool in patients with syncope
- No significant agreement on what an abnormal ECG is
  - Ultimately you would like a simple definition that EM physicians can utilize
- How often does syncope present as Myocardial Infarction?
  - McDermott, DA, Quinn, JV-CJEM 2008

### Phase I

**SFSR vs Physician Decision Making**

- Physicians have good judgment
- Judgment is variable and physicians don’t trust it
- Physicians admit a large number of low risk patients
- SFSR could decrease admissions by 10%

*Quinn, JV, Stiell, IG, McDermott, DA, et al. AJEM, October 2005*

### Syncope and ECG

- Abnormal ECG’s can be vague and nonspecific
- Our EM based definition was as follows:
  - Any rhythm that was not sinus
  - This also included monitoring while in the ED
  - Any changes on the ECG thought to be new
- Most likely serves as a marker for underlying heart disease and subsequently high risk for serious outcomes
- Probably warrants more aggressive cardiology workup
**Syncope and ECG**

**Myocardial Infarction**

- Prospectively enrolled patients with syncope or near syncope
- Patients determined as normal vs. abnormal ECG
- Patients then identified as diagnosed with Acute Myocardial Infarction at 7 or 30 days
- Kappa Statistic to compare 3 groups
  - Expert EM and Expert Cardiologist-Blinded
  - Emergency Physicians
  - Formal Cardiology read

*McDermott, DA, Quinn, JV-CIJEM, 2008*

**Syncope and ECG**

**Results-Myocardial Infarction**

- 46 of 1475 patients (3.1%) were determined to have AMI, most being non q-wave MI (42/46)
- An initial ECG was abnormal in 37/46
  - 80% sensitive (95% CI 67% - 89%)
  - 61% specific (95% CI 60% - 62%)
  - 99% NPV for predicting AMI (95% CI 98-100%)
  - 7% PPV (95% CI 6-8%)
- The ECG has a low sensitivity and specificity for predicting AMI, but a high NPV because of the low incidence of AMI in patients with syncope

*McDermott, DA, Quinn, JV-AEM, July 2011*

**Syncope and ECG**

**Our criteria are relatively simple, but not always correctly applied**

- Any non sinus rhythm from any source
  - 12 lead ECG
  - ED Cardiac monitoring or pre-hospital strips
- Any new or age indeterminate changes

**High risk findings**

- Any non sinus rhythm-OR-2.8
- Any LBBB-OR-3.2

*McDermott, DA, Quinn, JV-AEM, July 2011*

**The San Francisco Syncope Rule to Predict Patients with Serious Outcomes**

- Chf, Hct, Ekg, SBP, SOB
- Abnormal EKG
- Complaint of SOB
- HCT < 30
- SBP < 90
- History of CHF

*Additional Reference: UpToDate- The Approach to the Patient with Syncope in the Emergency Department*