Seek and Ye Shall Find: Surprising Findings When Using the ILR-LINQ

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October 31, 2015

Disclosures: Consultant to Boston Scientific, Medtronic, Sorin, and St. Jude Medical
Tools for Diagnosis and Evaluation

External Ambulatory ECG Monitoring

A. Holter monitoring
Patient wears monitor (typically 24-48 hours)
Patient keeps diary of symptoms and times when they occur
Patient returns monitor to technician to be scanned after recording period
Technician gives physician final report

B. Event monitoring
Patient carries monitor (typically 30 days)
Patient places monitor on chest to record during symptom
Patient transmits data over telephone to monitoring station
Monitoring station sends data to physician

C. Loop monitoring
Patient wears monitor (typically 30 days)
Patient activates monitor during symptom (some devices auto-trigger if arrhythmia is detected and alert patient)
Patient transmits data over telephone to monitoring station
Monitoring station sends data to physician

Mittal S et al. JACC 2011; 58: 1741-1749
Tools for Diagnosis and Evaluation

Second Generation External Ambulatory ECG Monitoring

A. Holter monitoring
   Patient wears monitor patch (up to 7-14 days)
   Patch monitor records all ECG data during period
   Patient mails back monitor after recording period to central receiving station
   Technician reviews data and sends report to physician

B. Ambulatory Telemetry monitoring - (Non-Real Time)
   Patient wears monitor (up to 30 days)
   Monitor sends all ECG data to a handheld device
   The handheld device transmits ECG data to a central monitoring station
   Physicians are notified by technician if significant arrhythmia is detected

C. Ambulatory Telemetry monitoring - (Real Time)
   Patient wears monitor (up to 30 days)
   Monitor sends all ECG data continuously to central monitoring station
   Physicians are notified by technician if significant arrhythmia is detected
   Physicians can also log onto secure web server at any time to view real time ECG data
ILR Based Daily ECG Monitoring

- Reveal LINQ™ ICM
- MyCareLink™ Patient Monitor
- Cellular
- Patient Assistant
- Simplified Insertion Procedure
- Streamlined Reports
Candidates for ILRs

• Unexplained palpitations
Case Presentation

• 75-year old female with hypertension and a recent history of paroxysmal episodes of palpitations associated with chest pain and pre-syncope.

• Her baseline ECG and echocardiogram were normal.

• Diagnostic evaluation:
  – 24-hour Holter: negative
  – Cardiac catheterization: no coronary artery disease and normal LV function

• Primary concern: Patient has a CHA$_2$DS$_2$-VASc score of 4 based on her age, gender, and history of hypertension. Is she having atrial fibrillation?
Case Presentation

- 8 weeks following ILR implant, she had recurrent symptoms
- The ILR recorded a “tachy” episode, which lasted 9 minutes and 30 seconds
Case Presentation

ECG Detail:  Tachy (ID# 14), 26-Jan-2015

Detection: 14:38:00  Terminated: 14:47:18
Case Presentation
Candidates for ILRs

- Unexplained palpitations
- Unexplained syncope
Brugada syndrome
hypertrophic cardiomyopathy
short or long QT syndrome

ventricular tachycardia
or ventricular fibrillation

sinus node, AV node,
and/or His-Purkinje system
dysfunction
ESC Syncope Guidelines: Recommendations for ILRs

• Class I (Indications)
  – An early phase of evaluation in patients with recurrent syncope of uncertain origin, absence of high risk criteria, and a high likelihood of recurrence within longevity of the device

Case Presentation

• 83-year old obese female with hypertension and diabetes was admitted following her 4th syncopal episode in the past 2 years.

• Her baseline ECG and echocardiogram were normal.

• During her most recent episode, she was standing in her kitchen talking with her daughter when she started to feel light-headed and then had frank syncope.
  – She hit the back of her head but quickly regained consciousness
  – There was no post-ictal state
Case Presentation

- 46-year old male presented for evaluation because of frequent episodes of palpitations (typically during periods of exertion) as well as frequent episodes of pre-syncope (typically when he is lying down).

- He denied any episodes of syncope.

- In addition, he had a strong family history of sudden death. His brother died suddenly at age 25 and his father died suddenly at age 44; an autopsy demonstrated a ruptured aortic aneurysm in the father.

- The patient had previously used a 30-day event recorder; no symptoms occurred during the monitoring period.
Case Presentation

- Recurrent pre-syncope while driving
ESC Syncope Guidelines: Recommendations for ILRs

• Class I (Indications)
  – An early phase of evaluation in patients with recurrent syncope of uncertain origin, absence of high risk criteria, and a high likelihood of recurrence within longevity of the device
  – High risk patients in whom a comprehensive evaluation did not demonstrate a cause of syncope or lead to treatment

Case Presentation

• 70-year old female referred in April 2014 for evaluation following 2 episodes of syncope.

• She had known moderate mitral regurgitation and LBBB.

• Malignancies
  – In September 2012, she was diagnosed with breast cancer and underwent bilateral radical mastectomy followed by chemotherapy and radiation.
  – Unfortunately, in early 2014 she was diagnosed with acute myelogenous leukemia.

• While in the midst of chemotherapy, she had 2 episodes of syncope. The second episode resulted in a subdural hematoma, subarachnoid hemorrhage, and a laceration to her forehead.
Case Presentation

- Diagnostic evaluation
  - An echocardiogram showed mild left ventricular dysfunction (ejection fraction 40-45%)
  - A nuclear stress test showed no perfusion defects and confirmed the mild left ventricular dysfunction.
Question To Ponder

• What would you recommend next?
  1. Tilt table test
  2. Electrophysiology study
  3. Loop recorder implantation
  4. Pacemaker (+/- LV lead)
  5. ICD (+/- LV lead)
17 (33%) pts - AV block
23 (44%) pts – received PPM
AV block tended NOT to develop in pts with
- Isolated RBBB
- Patients with a > 2 year history of syncope
Syncope: Pacing or Recording in the Later Years (SPRITELY)

• Inclusion criteria
  – Age > 50 years, and
  – >1 syncopal spell within 1 year preceding enrollment, and
  – Bifascicular block on a 12-lead ECG

• Randomization: ILR vs (single or dual chamber) PPM

• Primary endpoint: composite at 2-years of one of the following – syncope, symptomatic bradycardia, asymptomatic CHB, acute and chronic ILR and PPM related complications, and death
Case Presentation

- She was advised by another consultant to consider dual chamber ICD implantation.
- Following a second opinion, she underwent a His-bundle study, which showed a HV interval of 64 msec.
- She received an ILR for long-term ECG monitoring.
- Four months later, she suffered another syncopal episode while walking from her bed to the bathroom.
- She suffered a fracture of her left arm.
- The patient’s husband immediately used the patient activator to store the patient’s ECG. No arrhythmia was recorded during the episode.
ESC Syncope Guidelines: Recommendations for ILRs

• Class I (Indications)
  – An early phase of evaluation in patients with recurrent syncope of uncertain origin, absence of high risk criteria, and a high likelihood of recurrence within longevity of the device
  – High risk patients in whom a comprehensive evaluation did not demonstrate a cause of syncope or lead to treatment

• Class IIa (Indications)
  – An ILR should be considered to assess the contribution of bradycardia before embarking on cardiac pacing in patients with suspected or certain reflex syncope presenting with frequent or traumatic syncopal episodes

Case Presentation

- 78-year old female with known hypertension, hypercholesterolemia, and coronary artery disease.
  - History of PCI
  - Normal ECG and echocardiogram
- She had multiple episodes of pre-syncope and syncope, all of which sounded neurally-mediated in etiology.
- She presented following another episode of syncope
  - Resulted in spinal cord injury – transient paralysis
  - Electrophysiology study – unremarkable
- **Primary question:** Do we implant an ILR, a pacemaker, or do nothing?
Case Presentation

ECG Detail: Pause (ID# 16), 27-Aug-2014

▼ Detected: 09:02:48
■ Terminated: 09:03:48

Pause Detected
Case Presentation
512 Patients With an ILR

89 Patients with Syncope

77 Patients Agreed to PPM

38 Patients PPM ON

39 Patients PPM OFF

- Age ≥ 40 years; EF > 40%
- ≥ 3 syncopal episodes in past 2 years, likely due to NMS
- Syncope + asystole ≥ 3 secs
- Asystole ≥ 6 secs
Brignole M et al. *Circulation* 2012; 125: 2566-2571
Candidates for ILRs

- Unexplained palpitations
- Unexplained syncope
- Atrial fibrillation
  - Suspected (e.g., cryptogenic stroke)
Case Presentation

- 66-year old right-handed male with hypertension (on lisinopril), diabetes (on metformin), and hypercholesterolemia developed left arm numbness and clumsiness along with difficulty speaking
  - Symptoms resolved in 10 minutes
Case Presentation

- ECG: normal
- TEE: bicuspid aortic valve with mild aortic calcification, mitral annular calcification, mild-moderate mitral regurgitation, normal ventricular function, no evidence of patient foramen ovale
- Head CT, CT angiogram, carotid and trans-cranial Doppler examinations all within normal limits
- Head MRI:
  - Acute right frontal lobe infarct
4 Months Later – Asymptomatic
5 Hours and 36 Minutes

Atrial Fibrillation
Real World Data: Richards M et al. ISC 2015

- 1247 patients
- Median follow-up: 182 days [IQR: 152-182 days]
- 1521 AF episodes in 147 patients

Median time to AF detection: 58 [IQR: 11-101] days
Candidates for ILRs

- Unexplained palpitations
- Unexplained syncope
- Atrial fibrillation
  - Suspected (e.g., cryptogenic stroke)
  - Patients at high risk for developing AF
    - Atrial flutter
    - Post-pulmonary vein vein isolation
Risk of Stroke in Patients With Atrial Flutter

Lee A. Biblo, MD, Zhong Yuan, MD, PhD, Kara J. Quan, MD, Judith A. Mackall, MD, and Alfred A. Rimm, PhD

![Graph showing risk of stroke over follow-up time for different atrial arrhythmias]
Case Presentation

- 62-year old female with hypertension and an unexplained TIA episode 25 years ago (no further details) presented with palpitations and was found to have paroxysms of typical atrial flutter
  
  - CHA$_2$DS$_2$-VASc score = 2 or 4

- An echocardiogram showed a dilated left atrium and normal left ventricular function

- At electrophysiology study, typical counterclockwise isthmus-dependent atrial flutter was inducible and successfully ablated
Question to Ponder

• How long should anticoagulation be continued?

1. For one month post-ablation only

2. For one month post-ablation and then resumed if intermittent/continuous ECG monitoring shows AF

3. Indefinitely
Case Presentation

ABLATION 9/14/2010

MULTIPLE EPISODES OF AF AS LONG AS 6 HOURS; ALL ASYMPTOMATIC
Case Presentation

Patients Were Considered to Have AF only if Stored ECGs Confirmed Presence of AF

Mittal S et al. *Heart Rhythm* 2013; 10: 1598-1604
Case Presentation

- 49-year old male with hypertension, diabetes mellitus, obstructive sleep apnea, and paroxysmal atrial fibrillation
  - $\text{CHA}_2\text{DS}_2\text{-VASc}$ score = 2
- He underwent cryoballoon based pulmonary vein isolation on May 15, 2013
  - Last known recurrence of atrial fibrillation occurred on May 30, 2013
  - He is maintained on Xarelto 20 mg daily, which he wishes to discontinue
  - ILR Implanted April 29, 2014
Case Presentation

- Recurrent episode of AF on January 10, 2015, nearly 18 months out from index ablation
Duration of Follow-Up: Very Late Recurrences of AF

- Rhythm Evaluation for Anticoagulation Therapy with Continuous Monitoring

- CHADS\textsubscript{2} score of 1 or 2

- Non-continuous AF in whom a rhythm control strategy has been adopted (ablation, surgery, AAD) or patients with infrequent episodes of AF (none > 1 hour in 3 consecutive months) without a rhythm control strategy
AF Monitoring
1. Scheduled Daily Transmission
2. Patient Initiated Transmission
3. Alert Triggered Transmission

AF Duration
≥ 1 Hour

Anticoagulation
D/C ASA

Freedom from AF
Duration ≥ 1 Hour for 30 consecutive days

STOP Anticoagulation
Start ASA

Continue Anticoagulation

YES

NO
Candidates for ILRs

- Unexplained palpitations
- Unexplained syncope
- Atrial fibrillation
  - Suspected (e.g., cryptogenic stroke)
  - Patients at high risk for developing AF
    - Atrial flutter
    - Post-pulmonary vein isolation
  - Known
    - Establish pattern of atrial fibrillation
    - Evaluate burden of atrial fibrillation
    - Guide decisions regarding further therapy
**Case Presentation**

- ILR detected episode of atrial fibrillation
  - Multiple such episodes recorded by the device

<table>
<thead>
<tr>
<th>ID#</th>
<th>Type</th>
<th>Date</th>
<th>Detected hh:mm</th>
<th>Duration hh:mm:ss</th>
<th>Max V. Rate</th>
<th>Median V. Rate</th>
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<tr>
<td>28</td>
<td>AF</td>
<td>17-Apr-2014</td>
<td>10:21</td>
<td>00:02:00</td>
<td>207 bpm</td>
<td>188 bpm</td>
</tr>
</tbody>
</table>
Case Presentation
Candidates for ILRs

• Unexplained palpitations
• Unexplained syncope
• Atrial fibrillation
  – Suspected (e.g., cryptogenic stroke)
  – Patients at high risk for developing AF
    • Atrial flutter
    • Post-pulmonary vein isolation
  – Known
    • Establish pattern of atrial fibrillation
    • Evaluate burden of atrial fibrillation
    • Guide decisions regarding further therapy