What to do with an abnormal Holter result

A practical guide to avoiding difficult situations

Management of a few of the common findings
Conflicts

• None
What to do with an Abnormal Holter

Pt. 1 Dx: Sinus node dysfunction, 1º AVB, RBBB
What to do with an Abnormal Holter

• Usually we are evaluating for:
  – Symptoms
    • Palpitations
    • Dizziness
  – Events
    • Syncope
    • Sudden cardiac arrest

• Occasionally for asymptomatic reasons
  – Heart rate control during persistent AF
  – Evaluate for occult AF
Retrospective Analysis of Ambulatory ECG

- 7,364 24 hour monitors
  - 21% were ordered for syncope evaluation
  - Yield:
    - Syncope/near syncope w arrhythmia: 2%
    - Syncope/near syncope w/o arrhythmia: 15%

- Poor sensitivity
  - Can be improved by longer monitoring

- Poor specificity
  - Can be improved by using patient activated method

Gibson TC. Am J Cardiol. 1984;53:1013-1017
Pt. 1 Symptom Diary

<table>
<thead>
<tr>
<th>Strip #</th>
<th>Time</th>
<th>Date</th>
<th>Marker</th>
<th>Arrhythmia</th>
<th>Symptoms/Activities</th>
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Arrhythmia frequency, monitor duration, and likelihood of detection

- If the patient is in PAF 26% to 50% of the time, likely to detect with 48hr monitor
- If in PAF only 1% of the time, unlikely to detect with 48hr monitor; 95% detected in 5 days
- Most arrhythmias are much less frequent than this hence need longer monitoring
- Only about half of the episodes of AF are associated with symptoms

Turakhia MP, Am J Cardiol 2013;112:520-524
Improving sensitivity and specificity

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

A. Patch-Type Extended Holter monitoring
- Patient wears monitor patch (up to 7-14 days)
- Patch monitor records all ECG data during period
- Patient transmits data over telephone to central receiving station
- The handheld device transmits ECG data to a central monitoring station
- Physicians are notified by technician if significant arrhythmia is detected

B. Ambulatory Telemetry monitoring - (Non-Real Time)
- Patient wears monitor (up to 30 days)
- Patient mails back monitor after recording period to central receiving station
- 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 on to secure web server at any time to view real-time ECG data
iRhythm Patch

Like a Holter, it records every beat, and has a symptom trigger button.
Stays on the skin and records up to 14 days (median = 10); patient can shower.
Much less intrusive than most recording devices; is peeled off and mailed back.
Zio® Patch Report for
Report #1, Training

Date of Birth
Patient ID
Gender
Primary Indication
Arrhythmia (unspecified)

Prescribing Clinician
Dr. E. Physician
Managing Location
INCC Lincolnshire
This report is a compilation of multiple patients' arrhythmias.

Enrollment Period
13 days 16 hours
02/22/13, 01:22pm to
03/08/13, 05:03am
Analysis Time
13 days 11 hours
(after artifact removed)

Heart Rate
Maximum HR
212 bpm (at 07:52pm on 03/04)
Minimum HR
29 bpm (at 03:46pm on 02/23)
Average HR
72 bpm

Patient Events
Number of Triggered Events: 3
Findings within ± 45 sec of Triggers:
AV Block, Supraventricular Tachycardia, Sinus Rhythm, Ventricular Ectopic beat(s),
Supraventricular Ectopic beat(s)

Number of Diary Entries: 3
Findings within ± 45 sec of Entries:
Atrial Fibrillation, AV Block, Pause(s), Sinus Rhythm, Supraventricular Ectopic beat(s)

Ectopics
Rare: 0 to <1.0%
Frequent: 1.0% to <5.0%

Supraventricular Ectopy (SVE/PACs)
Isolated
Frequent
Couplet
Occasional
Triplet
Occasional

Ventricular Ectopy (VE/PVCs)
Isolated
Couplet
Triplet

Final Interpretation
1- Sinus rhythm with first degree AV block.
2- Episodes of second degree AV block.
3- Sinus pauses with longest being 5.4 seconds.
4- Frequent isolated PACs with occasional atrial couplets and triplets.
5- Many runs of SVT many of which appear to be ectopic atrial tachycardia (5873) with longest being 30 sec.
6- Rare: <1.0% 5154
7- Runs of VT up to 10 beats range of 135-182/min.
8- Atrial fibrillation with a burden of 12% with rates of 40-510/min.
9- Symptoms appear to correlate with SVT, sinus pauses, AV block and atrial fibrillation.

Signed by Dr. Example Physician on 03/17/13 at 03:41 PM (CT)
Smartphone devices for inexpensive long-term monitoring

Alivecor: [www.alivecor.com](http://www.alivecor.com) $200 Prescription
Cardiac Designs: [www.cardiacdesigns.com](http://www.cardiacdesigns.com) $100 OTC
Implantable Loop Recorders

PICTURE registry: Recurrent unexplained syncope or presyncope
570 patients had undergone evaluation by an average of three different specialists
9 – 20 nondiagnostic tests (median 13)
Syncope occurred in 30% of patients the first year; in 78% of those a dx was made

Edvardsson N. Europace. Feb 2011;13(2):262-269
Patient Activated Pacemaker Recordings

Episode #17: 28-Jan-2014 04:24:29

Episode Summary
- Initial Type: AT/AF Monitor (spontaneous)
- Duration: 3.4 hr
- A/V Max Rate: 462 bpm/200 bpm
- A. Median: 261 bpm (230 ms)
- Activity at onset: Rest, Sensor = 60 bpm

Monitored AT/AF Episode #17
- Device: Advisa DR MRI A2DR01
- Serial Number: PVY223504H
- Date of Visit: 28-Jan-2014 08:42:17

Atrium
Ventricle
### Patient 1

<table>
<thead>
<tr>
<th>Minimum: 36</th>
<th>at: 10:00:36</th>
<th>12-Nov-2013</th>
<th>Longest RR: 2.880</th>
<th>sec at: 10:11:52</th>
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<td>Average: 66</td>
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**Acq duration:** 47:59

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**Graphical Representation:**

- **Channel 1**
  - 

- **Channels 2 & 3**
  - 

- **Channel 4**
  - 

**N-N Pause:** 2880 ms

**Date & Time:** 12-Nov-2013 10:11:50

**Heart Rate:** 56 BPM
Some Class 1 Pacing Indications
Principal: Reduction of Symptoms and Events

• Symptomatic bradycardia or chronotropic incompetence
  – Except due to unnecessary medical therapy

• Asymptomatic third degree and advanced second degree heart block (while awake) with pauses > 3 seconds or escape rate < 40, or during AF, > 5 sec

• Advanced second degree HB, intermittent third degree HB, or alternating bundle branch block in the setting of chronic bifascicular block

• Patient 1 had RBBB and sinus pauses of 2.8 sec but did not have evidence of advanced heart block or other criteria
Pt. 2. Palpitations and dizziness:
3 events during 48 hours

Normal AV conduction, asymptomatic sinus pauses 4.28 sec
Pt. 3: Paroxysmal AF, symptomatic
Management of PAF
Principal: Reduction of Symptoms and Events

• Asymptomatic
  – Proper anticoagulation

• Symptomatic
  – Proper anticoagulation, plus
    • Nothing, if sx infrequent, brief, mild
    • “Pill in the Pocket” if infrequent, prolonged episode
    • Continuous medical therapy if frequent episodes
    • Ablation or surgery if medical options ineffective
Atrial Flutter – “Typical”

1. Consistent flutter waves – morphology and cycle length
2. Inverted in the inferior leads
3. Upright in V1
Pt. 4: NSVT, Asymptomatic
Management of NSVT

• Asymptomatic
  – Normal LV function:
    • Usually conservative management, i.e. nothing

• Symptomatic
  – Normal LV function
    • Beta blockers, Ca++ blockers, ablation

  – Depressed LV function
    • Standard medical treatment of LV dysfunction x months
    • Repeat measurement of LV function
    • May be candidate for prophylactic ICD if not improved
RF delivered to that site during VT

VT terminates about 1 sec later
The role of these devices

<table>
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<tr>
<th>Duration</th>
<th>Method</th>
<th>Pro</th>
<th>Con</th>
<th>Utility</th>
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<tr>
<td>Short</td>
<td>Automated BP cuff</td>
<td>Inexpensive</td>
<td>Low quality data</td>
<td>Lots</td>
</tr>
<tr>
<td></td>
<td>EKG in clinic or EMTs</td>
<td>Inexpensive; high quality</td>
<td></td>
<td>Lots</td>
</tr>
<tr>
<td></td>
<td>Holter</td>
<td>High quality</td>
<td>Not very long</td>
<td>Lots</td>
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<td>iRhythm Patch</td>
<td>Pt + Auto; up to 2 weeks</td>
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<td>Lots</td>
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<td>HeartCard</td>
<td>Easy</td>
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<td>Lots</td>
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<td>Event Monitor</td>
<td>Pt activated or auto-activated</td>
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<td>Lots</td>
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<td>Mobile Continuous Outpatient Telemetry</td>
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<td>Too much data and cost</td>
<td>I never use it</td>
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<td>Smartphone accessory</td>
<td>Inexpensive</td>
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<td>Great for infrequent sx in the savvy patient</td>
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<tr>
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<td>Implantable Loop Recorder</td>
<td>Lasts 3 years. Auto-activated</td>
<td>Expensive</td>
<td>Best for infrequent sx in the infirm patient</td>
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<tr>
<td>Long</td>
<td>Pacemaker reprogram</td>
<td>Very high quality data</td>
<td></td>
<td>Always use if pacemaker is present</td>
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Summary

• Give thought to the various monitoring methods beforehand and you will improve sensitivity and eliminate many false alarms
  – Patient activated modalities are especially helpful

• Consider some of the low tech methods
  – Automated BP cuff, Fire station, clinic EKG

• Consider some of the high tech methods
  – iRhythm patch, AliveCor or Cardiac Designs monitors, reprogramming of pacemaker (if present) to enable patient activated recording function

• If recordings are in a grey area, don’t hesitate to call
Atrial Flutter / Atrial Tach
An Approach to the Abnormal Holter: Based on symptoms, events, and their relationship

- Asymptomatic incidental findings are a major problem and can be avoided by using patient activated modalities
- Recordings without a symptomatic episode can usually be avoided by choosing a more prolonged modality
Finding Earliest Ventricular Activation

ECG Leads

70 msec

Ablation Catheter
EKG of patient with 2.8 sec pauses

She has RBBB but not bifascicular block, asymptomatic pauses < 3 sec