What causes my heart rhythm disorders?

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“You can observe a lot by just watching”

Yogi Berra
Some of my self-tracking over past 12 years

- Blood pressure vs. weight loss, exercise, medications
- Atrial fibrillation (cardiac rhythm disorder) vs. plausible transient daily triggers
- Deep sleep (ZEO) vs. aerobic exercise, caffeine, sex, other
- MyFitnessPal dietary tracking, exercise vs. body weight/percent body fat (Tanita).
Self-tracking over past 12 years

- Blood pressure vs. weight loss, exercise, medications
- Atrial fibrillation (cardiac rhythm disorder) vs. plausible transient daily triggers
- Deep sleep (ZEO) vs. aerobic exercise, caffeine, sex, other
- MyFitnessPal dietary tracking, exercise vs. body weight/percent body fat (Tanita).
Some Tachycardias (Heart Rate > 100 beats per minute)

- Paroxysmal Supraventricular Tachycardia (PSVT)- AV node Reentry (benign)
- PSVT AV Reentry (benign)
- Atrial flutter (relatively benign)
- Atrial fibrillation (stroke, heart failure)
- Wolff-Parkinson-White syndrome (sudden cardiac death)
Normal electrical conduction through heart
Can I measure triggers, and then avoid them, to decrease these unpleasant and dangerous events?
Created simple Excel table of all episodes for one year

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Length</th>
<th>Where</th>
<th>Self dx</th>
<th>Onset</th>
<th>Offset</th>
<th>Symptoms</th>
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<tr>
<td>Est. Heart rate</td>
<td>Recorded with HRM?</td>
<td>Possible Triggers</td>
<td>comments</td>
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</table>
First, what type of arrhythmia?

- Used description of symptoms and signs to categorize as AF or PSVT
  - Choking feeling, irregular heart beat, impending doom, lightheaded - prodrome
  - Very rapid and regular heart beat, sometimes lightheaded
Attempted treatment trial

- Magnesium supplement 250 mg per day
Episodes per month

- Magnesium 250 mg
- Magnesium 500 mg

- SVT
- AF

- Episodes per month chart for 2008 and 2009 with magnesium dosage change.
Conclusion from trial

- 7 to 8 fold decrease in SVT
- No decrease in AF
- Other factors at play
  - Seasonality
  - Decreased exercise level
  - Compare to previous year?
  - No control
“The first principle is that you must not fool yourself, and you are the easiest person to fool”

Richard Feynman, PhD
What about the triggers?  
Can they be described?  
Can they be quantified?
Case-Crossover Design is a scientific way to ask and answer the question that “Was the patient doing anything unusual just before the onset of the disease?”
To answer this question, we need to do the comparison within the individual.

I’m so sick....

Did I do anything unusual right before the illness in comparison to my usual routine?
It is a design that compares the exposure to certain agent during the interval when the event does not occur (control period), to the exposure during the interval when the event occurs (hazard period).
Control Data

The control data can be

(1). exposure information from a comparable time period; or

(2). exposure information in the past according to the individual’s usual frequency of exposure.
Analysis  If the control data were from the past exposure ..... 

Step 1. Calculate the concurrence observed odds \((a:b)\). 

Odds that the exposure was during the hazard period right before the onset of disease.  

\((1:0)\) if there was exposure in hazard period.  
\((0:1)\) if there was no exposure in hazard period.
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We will use the same method for a standard matched case-control study. But instead of case and control, we will have Hazard period and Control period.

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</tr>
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<tbody>
<tr>
<td>Exposed</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>Unexposed</td>
<td>c</td>
<td>d</td>
</tr>
</tbody>
</table>

OR = b/c
SVT risk factors:

- Common events preceding attacks in the previous 1 hour:
  - High intensity exercise  OR ~ 4.0
  - Afternoon caffeine   OR ~ 3.0
  - Public speaking large groups  OR ~ 3.0

- Common events in the previous 12 hours:
  - Inadequate sleep   OR ~ 3.0
Atrial fibrillation risk factors

- Common events preceding attacks in the previous 2 hours:
  - Caffeine at any time
  - Air flight stress
  - >1 glass of wine
  - Public speaking large groups

- Common events preceding attacks in the previous 12+ hours:
  - Inadequate sleep
Take home message from tracking

- I used this information to minimize precipitants, and decreased the number of both types of episodes
- The additional information aided my cardiologists to make better decisions about which type of procedure to cure which rhythm problem
Where do self-tracking studies go in science, the levels of evidence?
The Evidence Pyramid: Types of Research Studies

- Randomized Controlled Double Blind Studies
- Cohort Studies
- Case Control Studies
- Case Series
- Case Reports
- Ideas, Editorials, Opinions
- Animal research
- In vitro ('test tube') research
- Systematic Reviews and Meta-analyses
Levels of Evidence: Treatment

Less bias
1 - 1 or more randomized controlled trials
2 - 1 or more cohort studies
3 - 1 or more case-control studies

More bias
4 - 1 or more case-series
5 - expert opinion without above evidence

Bias = systematic error
The Evidence Pyramid: Types of Studies

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- Case Reports
- Ideas, Editorials, Opinions
- Animal research
- In vitro ('test tube') research
Levels of Evidence: Groups of people

1 - 1 or more randomized controlled trials
2 - 1 or more cohort studies
3 - 1 or more case-control studies
4 - 1 or more case-series
5 - expert opinion without above evidence

Bias = systematic error
What type of study design is this information?

What is the scientific level of evidence?
Levels of Evidence: Within one person

Less bias
1 - 1 or more **randomized controlled trials** – “n of 1” trial
2 - 1 or more **cohort studies**
3 - 1 or more **case-crossover studies**

More bias
4 - 1 or more **case-series**
5 - **informed opinion** without above evidence

Bias = systematic error
Summary

- Self tracking can aid in the identification of precipitating factors in a potentially life-threatening heart condition.
- Single subject designs as used by QS proponents deserve further study, validation and publication.
- Single subject designs have their place in science and evidence-based medicine and
Thank you for your kind attention!

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Extra slides
AVRT risk factors

- Obesity
- Alcohol consumption
- Electrolyte imbalance
- Males
- Older than 40
Atrial flutter risk factors

- Obesity
- Alcohol consumption
- Electrolyte imbalance
- Males
- Older than 40
Known Atrial Fib risk factors

- Coronary heart disease
- Valve disease
- Inflamed heart muscle or lining
- Diabetes
- High blood pressure
AF risk factors in healthy people...

- Stressed or fatigued
- Too much caffeine or alcohol
- High intensity exercise
- Too little magnesium, potassium
- “big meal”
Example  MI and physical exertion

Control data 2:

The usual frequency of heavy physical exertion over the past year.

Amount of person-time exposed to physical exertion over the past year

Physical exertion during hazard period?
Case Crossover Design

- It is related to **prospective crossover** design.
- It is a matched **case-control** study but involves cases only and each individual serves as his/her own control.
- The data from a case crossover design can also resemble **cohort data** if the control data are units of person-time.
Effect Period of the Exposure

“... the period of altered risk in a population, to be the difference between the minimum delay before impact and the maximum carry-over time.”

By MacIure M (AJE 1991;133:144-53)
Effect Period of the Exposure
Hazard Period

The period of time right before the onset of the event. Usually the length of hazard period is the same as the length of the exposure effect period.
Control Data

The control data can be
(1). exposure information from a comparable time period; or
(2). exposure information in the past according to the individual’s usual frequency of exposure.
Example

Triggering of MI by physical exertion
(NEJM 1993;329:1677-83)

- Event: Myocardial Infarction (MI)
- Exposure: Heavy physical exertion
- Length of the exposure effect: 1 hour
- Hazard period: 1 hour before MI onset

2 sets of control data were used.
Example  MI and physical exertion

Control data 1:

The physical exertion information from a 1 hour period at the same time on the day before the onset of MI.
Example MI and physical exertion

Control data 2:

The usual frequency of heavy physical exertion over the past year.

Amount of person-time exposed to physical exertion over the past year

1 hr (Hazard Period)

MI

Physical exertion during hazard period?
**Analysis**  If the control data were from a comparable control period .....  

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Analysis  If the control data were from the past exposure …..

Step 2. Calculate the concurrence expected odds (x:y).

Odds that a random event (disease) would have fallen in the effect period after an episode of exposure.
Discussion
Case Crossover Design

- The design can only be applied when the time lag between exposure and outcome is brief and the exposure must have little carryover effect.
- The results of this analysis are short-term risks rather than cumulative risks.
Discussion
Case Crossover Design

- Recall bias may occur during data collection.
- If there is within-individual confounding, stratification of the data may resolve the problem. To control several confounders simultaneously, conditional logistic regression can be used.
Bibliography of Case Crossover Design Application


- Explosion of scientists
- Explosion of journals

*Science Since Babylon* by Derek da Solla Price, 1961, updated by David Goodstein, CalTech, 2002
Science or Evidence-Based Medicine

- Aim is to apply the best available evidence gained from the scientific method to clinical decision-making
- Method assesses the strength of evidence
- Randomized controlled trials or a summary of such trials (Systematic Review) is the highest level of evidence
- Expert opinion, or uncontrolled studies, are lowest
Levels of Evidence: Treatment

Less bias

1 - 1 or more *randomized controlled trials*

2 - 1 or more *cohort studies*

3 - 1 or more *case-control studies*

4 - 1 or more *case-series*

More bias

5 - *expert opinion* without above evidence

Bias = systematic error
Experimental or Controlled Trial Design

- Study Population randomize
- Experiment/Intervention
- Control
- Present
- Future
- diseased
- resolve
- diseased
- resolve
Randomized Controlled Trials

- Resembles a true lab experiment
- Has a control group with an active or inactive intervention (placebo)
- Randomization creates equal groups on known AND unknown risk factors
- Neither patients nor observers commonly know which group they are in - blinding
Controlled Trial or Cohort Design

Study Population

Intervention

Another intervention

Present

Future

diseased

resolve

diseased

resolve
Controlled Trials or cohort studies

- Some patients are given one treatment, some another
- No randomization - groups are not necessarily equal – statistical analyses may be done to equalize groups
- Blinding not commonly done
- Time sequence is clear
- Second best design
Case-series or follow-up of treated cases

Ill Study Population

Intervention

Still diseased

resolves

Control??

Present

Future
Case-series or follow-up of treated cases

- Common study design in clinical practice
- Lack of control group problematic esp. if clinical course of the condition is variable
- What would have happened in absence of treatment is not known
- Usually shows *inflated* estimates of true efficacy of therapy
- One of the weakest designs
Follow-up of treated case (self)

- Ill Study Population
  - Intervention
    - Still diseased
    - Resolves
      - Control??
  - Present
  - Future
Follow-up of treated cases (self)
Other tests

- Shoe weight vs. running efficiency
- Heel strike/Forefoot vs. running efficiency
- Aero Helmet design, wheel design vs. bike speed.
- Gel use and cycling power output