

Your Premier Information Resource for Lone Atrial Fibrillation
Publisher: Hans R. Larsen MSc ChE

<http://www.afibbers.org>

VIRTUAL LAF CONFERENCE

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SUBJECT: Monitoring Devices and Methods

INTRODUCTION

When I was first diagnosed with afib, like many others, I searched for a way to tame it. After I was diagnosed, I always "knew" when I was in afib. However, I believe that I had episodes for quite some time before I was diagnosed, so for that unknown period of time, I had "silent" afib. My purpose in writing this is to describe monitoring tools that have helped me, and to encourage others who use tools to do likewise. To the extent possible, I will post links to graphics of the output of these devices, on my web space. Hans has told me that these can be included in the final PDF of this Conference Room. If others would like to include graphics in their discussions, but do not have web space access, if they email the jpg graphics to me, I will post them, along with a link.

If you post, I would encourage you to include:

- the cost of the device,
- a location where it can be purchased,
- how you use it,
- positives and negatives associated with its use,
- any other comments.

I have done some searching of the board for past posts on devices and will include some of these so that future CR readers can have this in one place. The original authors and others are welcome to expand on these posts.

The day that I had my first known afib episode, I was taking my blood pressure with a stethoscope and cuff. Even though I don't have high blood pressure, I do this periodically. My bp was normal, but I noticed that my pulse sounded very "wired." I then manually took my pulse rate, which was 80 bpm. This was unusual for me, as my resting pulse is somewhere in the 50's. I put on an old Polar heart rate monitor that I had. It does not give a reading for every beat, but gives a 5 beat moving average. This monitor showed a very erratic pulse rate. When I went up the stairs, my rate shot up to 140 bpm. Normally it would have been 90. This convinced me to go to the ER and my journey with afib began.

A number of weeks after diagnosis, I started feeling my pulse for a few minutes before I went to sleep. An advantage of this pulse point is that it is easy to do lying down. I noticed that if I felt a lot of irregular beats, I would think "I bet I wake up in afib." Sure enough I was correct. I now know that the irregular beats I was feeling are PVC's. They feel like a "skipped" beat in the pulse count. I am not prone to a lot of PAC's, but they feel like a "quick" beat in the pulse count.

I also learned that afib just feels irregular. Maybe several beats seem normal, but then several do not.

Since I've gotten experience with this, I still use manual pulse monitoring method when I am away from electricity for

my other monitors. I will count my beats for up to say 120. I will count the number of ectopics I feel in that period. If the ectopic count is two or more per minute, I will take more potassium and taurine before bed. When I would wake up feeling like I was in afib, I would take my pulse and could confirm this feeling in four or five beats that I was in afib.

As I did more research on afib, I came across the data showing a change in heart rate variability (HRV) before the onset of afib. I also saw published information that an increase to 5 PAC's per minute preceded afib (there are people, such as George Eby, <http://www.coldcure.com>, who have had 5 PAC's a minute for years and not have afib). I also learned that drugs like Cialis and Viagra will increase the sympathetic nervous system. At this point I purchased an ECG setup that connects to a computer. I also purchased a Polar S810i heart rate monitor. Since all of my episodes started around 3 AM, I thought that perhaps I could develop an "early warning system." I could monitor myself and if my HRV or PAC count got into pre-afib range, I could have a computer wake me and I would take some Cialis or Viagra to increase my sympathetic system and stave off or prevent afib.

I actually took this to the point of getting my EP to approve and my GP to prescribe and give me Cialis samples. PC at the time, discouraged (rightfully, I think) this effort. I read an account of another poster who was also trying to use a med to increase the sympathetic nervous system. All he succeeded in doing was postponing the onset by 4 or 5 hours. However, Gunnar, has used Cialis as part of a program to keep PVC's and PAC's away. See: http://www.afibbers.net/forum/read.php?f=4&i=11077&t=10997#reply_11077

I also purchased a FreezeFramer, which essentially duplicates the function of the Polar S810i. However, it is better at real time display. The Polar will display an averaged heart rate in real time, but the FreezeFramer will display an instantaneous rate every 1/2 second. The Polar will show the rate of every beat after the data is downloaded in a non-real time mode.

The approach I decided to use was to use the Polar and FreezeFramer to monitor ectopic (PAC & PVC) rates. I hooked up the Polar at the same time as my ECG monitor and found that I could distinguish PAC's from PVC's on the Polar (I matched their signatures on the heart rate graph with the ECG waveforms and consistently got a 100% correlation between the ECG and heart rate monitor waveforms). I also found that the Polar and the FreezeFramer gave the same signature for PAC's & PVC's, even though the Polar measures ECG signals from a chest strap and the FreezeFramer measures the pulse wave in the arteries in your finger.

I used PAC and PVC rates per hour as a guide to determine the effectiveness of my supplement program. High rates meant I needed more supplements. Low rates meant the supplements were effective. My concept was that my objective was to stay out of afib. However, just being in or out of afib was a coarse feedback mechanism. I wanted something that gave me more information, sooner. I wanted to know if I was headed for afib, before I was there. My ectopic counts do just that.

What I do on a daily basis is to monitor myself while I meditate. This has the advantage of minimizing artefacts in the data. I usually monitor myself 10-12 hours after my last supplement intake. This gives me a "worst case" reading. I am most concerned about the evening reading, since I've always gotten afib in the early morning. If I have a "bad" reading in the evening, I will eat dinner and take supplements. Then I will do a short monitor prior to retiring for bed. If this still shows too high an ectopic count, I will take more K+ and taurine supplements before bed. If I'm away from my monitors, I will manually take my pulse before bed, counting beats and ectopics, say how many ectopics in 120 beats, which is about 2 minutes. This latter method requires nothing but my finger, not even a watch.

I will now go through and describe each of these monitoring devices individually.

MANUAL PULSE

From my story, the first measuring instrument is the cheapest - your fingers. I took my pulse. I find that the best location is just in front of the ear. If you place your index or middle finger on the bony ridge, just to the side of your eye socket, then follow just above the ridge straight back to the ear, you will find a pulse location just in front of the ear lobe. Pressing with a light to medium pressure, this is a great place (on me) to take a pulse rate. I can feel afib (irregular), PVC's (skipped beat) and PAC's (quick beat).

I also use the manual pulse to confirm any "weird" readings on my Polar monitor. The Polar can give erroneous

readings above 200 when the chest strap loses connection. I've had the monitor give me a reading of 230 and I take my manual pulse and get 75 BPM.

I highly recommend spending time with this, the cheapest of all monitoring devices. Learn what is normal for you.

http://www.afibbers.net/forum/read.php?f=4&i=6923&t=6893#reply_6923

Re: Rate control

Author: Pam (---.hsd1.md.comcast.net)

Date: 04-23-06 14:00

Connie: Find your pulse at your wrist by running your fingers down the inside from the inside of your thumb. Once you have located it just count for a full minute, or for 30 seconds and multiply X 2. It is even stronger at your antecubital space on the inside of your elbow not in the center, but slightly to the inside. It's hard to count when it's so fast and irregular, but you can get a general idea. The other thing is to buy a cheap stethoscope. You can get one at any medical supply store, then listen at your chest. You just move it around your left chest until you find the spot where you can hear it the best.

STETHOSCOPE

The next measuring device is very inexpensive. In the US, stethoscopes can be purchased for \$10-\$20 at the local pharmacy. As I mentioned above, I "heard" that my pulse sounded "weird." If you learn what afib sounds like for you, as well as PAC's & PVC's, the stethoscope can tell you a lot. I would just spend some time sitting quietly and listening. I generally use my finger in preference to my stethoscope, just because I'm lazy and my fingers can tell me most everything that the stethoscope can (for my needs).

Here are some other posts on the stethoscope:

atrial contractions and stethoscope

Author: Bob K. (---.anhmca.adelphia.net)

Date: 12-15-05 12:40

Can atrial contractions be heard with a stethoscope? For example, during NSR I hear

tah tah..... tah tah tah tah.....tah tah

Is the first "tah" of each pair the atrial contraction and the second "tah" the ventricular contraction?

If so, would not having the "tah tah" pair be a clear indication of afib and conversely would the presence of the "tah tah" pair be a clear indication of no afib?

I'm asking because I had what I would call an irregular heart beat where I heard the "tah tah" but the rate was very variable over time spans of a few seconds. I'm not sure if it was afib. While wearing a Polar heart rate monitor it registered rates between 66 and 85 BPM. About a 1/2 hour later the large variability went away and my heart rate was very regular in the 60's , i.e. what I would call normal for me.

Re: atrial contractions and stethoscope

Author: Thomas (---.dyn.optonline.net)

Date: 12-15-05 14:51

Hi Bob-

I posted a couple of times about using the stethoscope for detection of afib. There are multiple sites that have audio recordings of heart beats in various states of rhythm. In one of my posts I gave the link for one. Here is another one:

http://www.3m.com/us/healthcare/professionals/littmann/jhtml/sounds/normal_first_and_second_heart_sounds.jhtml

just google things like "first heart sound" etc

For me, when I'm in afib the first heart sound is barely audible and what I hear is dub, dub, dub, dub, instead of lub-dub, lub-dub. What you are describing sounds like multiple ectopics occurring during sinus rhythm.

Once you hear your heart in NSR and in then in unquestionable afib you will find it easier to recognize variations on these.

take care,
Thomas

Re: atrial contractions and stethoscope
Author: Bob K. (---.anhmca.adelphia.net)
Date: 12-15-05 17:01

Thanks Thomas, I took your advice and found

http://www.3m.com/us/healthcare/professionals/littmann/jhtml/sounds/normal_first_and_second_heart_sounds.jhtml

Apparently you can't hear atrial contractions with a stethoscope.

regards,
Bob

Re: atrial contractions and stethoscope
Author: Mark (---.cg.shawcable.net)
Date: 12-15-05 19:39

I have used a stethoscope extensively and I am now able to determine not only whether or not I am in afib or NSR, but I have identified a number of different types of afib that I experience. I have ranked them. Sometimes I am in afib with irregular beats but there is a rhythm, other times the beats are irregular and chaotic. I would recommend everyone with arrhythmias to get a stethoscope, it has helped me understand my heart a lot better.

Re: atrial contractions and stethoscope
Author: Pam (---.155.78.180.Dial1.Baltimore1.Level3.net)
Date: 12-16-05 04:04

Hi all:

A good stethoscope really helps in auscultating heart sounds (Littmann). Lub and Dub represent the snapping closed of sets of valves, as described below. At the end of atrial systole (contraction), the AV valves snap closed creating Lub, then ventricular systole (contraction) occurs, and with the snapping shut of the Aortic and Pulmonic valves, Dub sound is heard. Well, when we are in afib, even if the atria are quivering, the valves are still opening and closing which is what creates the Lub sound. It may be harder to hear, especially if the rate is very rapid and the rhythm very irregular.

"The most obvious of the heart sounds are the first and second sounds, or S1 and S2, which demarcate systole from diastole. The heart sound playing in the background on the introduction page of this site is a normal sinus rhythm, with a sharp S1 and S2 and no other significant sounds. S1 is the sound which marks the approximate beginning of systole, and is created when the increase in intraventricular pressure during contraction exceeds the pressure within the atria, causing a sudden closing of the tricuspid and mitral, or AV valves. The ventricles continue to contract throughout systole, forcing blood through the aortic and pulmonary, or semilunar valves. At the end of systole, the ventricles begin to relax, the pressures within the heart become less than that in the aorta and pulmonary artery, and a brief back flow of blood causes the semilunar valves to snap shut, producing S2."

<http://www.wilkes.med.ucla.edu/Physiomain.htm>

Re: atrial contractions and stethoscope
Author: Bob K. (---.anhmca.adelphia.net)
Date: 12-16-05 06:27

Good responses. I'm learning a lot.

There's a big diversity of sensations and symptoms of afib between different people and in the same person at different times. Since my case is relatively mild, I'm interested in detecting afib when it isn't obvious.

So far, it seems that we hear the opening and closing of valves from which we infer the activity of the ventricles. How to infer the activity of the atria from this is much less clear.

It's interesting that the ekg and the stethoscope complement one another. The electrical signals plotted in an ekg give information on the contractions of muscles, i.e. the atria and ventricles. The sounds from the stethoscope give information on valve closings and sometimes blood flow.

The ekg shows the atrial activity, for example fibrillation, but the stethoscope doesn't. From the valve closings that we hear with the stethoscope, we don't know for sure if the atria are fibrillating. It seems that the best we can do is to listen with the stethoscope while connected to an ekg and look for correlations between the stethoscope and ekg in order to be able to identify afib later when using the stethoscope alone.

http://www.afibbers.net/forum/read.php?f=4&i=10514&t=10463#reply_10514

Another Alternative
Author: J. Pisano (---.zoominternet.net)
Date: 06-08-06 21:28

You can also look into auscultation devices that provide you with a phonocardiogram.

I use the one from stethographics. It has been an invaluable tool for keeping track of my heart. In addition, you can use it for lung sounds as well. The software is very good at determining things like wheezes, rhonchi, squawks, and fine and course crackles. My son has Asthma and I use it also to keep track of him... You can download there demo at www.stethographics.com It will actually dump some of the heart and lung sounds onto your computer, so you can listen to them regardless of whether or not you have the software, I believe you can read the help files as well, which have sounds embedded into them...

It saves data as a standard wave file and you can send these via email or whatever.

If you are not familiar with auscultation of the heart, I would suggest that you take the time to realize the benefits of listening to your heart, regardless of the phonocardiogram software. Once you familiarize yourself with what you are looking for you can hear many things. The primary S1 and S2 sounds and even distinguish S3 and S4 sound if they are present. You can hear both systolic murmurs and diastolic murmurs, tricuspid regurgitation or mitral regurgitation, pulmonic stenosis, atrial septal defect and a whole host of other things. It actually is quite astonishing what can be heard. Many of the people here would have a stethoscope I would think, especially if you are keeping track of your blood pressure. If not, they are really inexpensive.

Oh, and once you hear your own afib, you will soon not forget it's sound...

The stethographics package includes the auscultation software, the stethoscope and also an invaluable multimedia CD ROM of how to actually listen for the above things and all kinds of audio examples of what you are listening for...

Not for everybody, but it certainly is overlooked quite often. If you don't want to spend the money for the whole kit, you can order the multimedia CD-ROM. It alone will help you know what to listen for...

There are a number of other manufacturers... you can check them out for yourself, Google auscultation software...
Joe

http://www.afibbers.net/forum/read.php?f=4&i=5709&t=5706#reply_5709

Re: diagnosis

Author: Pam (---.hsd1.md.comcast.net)

Date: 04-08-06 14:29

Do you have a stethoscope? If not you can buy one relatively inexpensive at a medical supply store. If your pulse, or auscultated heart beat is very irregular, it is afib.

Pam

EKG SENSOR

Here is a previous description of my home ECG sensor:

Here's a home EKG sensor for a little over \$200 I got the parts from Vernier Software. This was designed for school science projects and has a specific disclaimer/prohibition for medical diagnostic uses, so if you order it, don't expect help from Vernier for using it with your afib!

Go! Link \$59 <http://www.vernier.com/go/golink.html> (requires a computer with a USB port).

EKG sensor \$142, comes with 100 electrodes (plugs into the Go! Link)

<http://www.vernier.com/probes/probes.html?ekg-bta&template=standard.html>

I use the lead II electrode placement as shown here:

<http://www.nceus.com/ekg/ekglead.html>

Since what you really carry about is waveform, the placement does not have to be exact. I move mine so they don't cover the hair on my chest. What you want is the triangle geometry.

The same site can help you interpret it (thanks for the reference to James Driscoll!)

http://www.nceus.com/course_frame.asp?exam_id=16&directory=ekg

The Go! Link comes with software that will work to display the info. I set up the software as follows – choose Experiment – Data Collection, then set the length of time you want to record in seconds (or change the units to minutes). I've sampled as long as 40 minutes. Then choose Options – Graph Options –Axis Options Tab. On the X-Axis set scaling to Strip Chart and Width to 7.

This will give a good imitation of a standard EKG rolling display.

You can copy the data to Excel or other programs for further analysis.

If you are a "techie" and want real time access to the data (this is NOT necessary for the average user!) they make an SDK for the Go! Link interface at <http://www.vernier.com/downloads/gosdk.html>

As I said – don't expect them to be happy if you tell them you're buying this stuff to monitor your afib, but I think it does a decent job. This is much cheaper than most medical EKG devices.

Also, like most HR measuring devices. You can get noise if you move around too much while measuring.

Advantages - inexpensive, gives you a 3 electrode look at your ECG trace

Disadvantages - The EKG strip takes a while to analyze. The data logger stores a huge amount of data. For example on a 26 minute test I did with the Polar & the EKG, the EKG had about 180,000 data points. The data logging software

takes a long time to reload it if you want to look at it again. A medical Holter monitor will have software that will count all of the irregular beats for you. With this device, you have to do the analysis yourself.

How I use it - mostly I used it to figure out what PAC's and PVC's look like on my Polar and Freezeframer output. I find that they are much less hassle and more efficient when looking at the data. I can look at several hours worth of Polar data in ten seconds.

If you wear the Polar chest strap and have the ECG leads on at the same time, you will get some noise, a constant sine wave like signal, on the ECG data. It makes it uglier, but does not prevent interpretation of the waveforms.

George

here is a post on another ECG device:

Re: Wil, PC: EKG monitor/holter info before buying
Author: Marian from Miami (---.mia.bellsouth.net)
Date: 06-08-06 14:54

Take a look at this monitor at: <http://www.activecenter.com/>

I have had one for 3 years and it has been invaluable in documenting the various rhythms my heart has presented. It is very portable, in fact it fits right into my pocketbook. It's possible to attach the three electrodes within minutes.

I bought a Palm Pilot on EBay to go with it. You simply plug it into your Palm Pilot to view and record Lead II or Lead I. Then Hot Synch it to your computer. The print outs are "beautiful" if you can call Afib beautiful, or at least the ones for sinus rhythm are! The strips can be taken or faxed to your EP. When you buy the monitor, you also get the software to load into your computer and Palm. Because I had these strips to document my rhythms, I was able to schedule my PVI last year much sooner than otherwise anticipated.

The machine records rhythms for 30 seconds at a time, and you can record 20 strips per patient before downloading them to your computer.

Marian

Re: Wil, PC: EKG monitor/holter info before buying
Author: Susan (---.socal.res.rr.com)
Date: 06-09-06 10:08

Active ECG is releasing a blue tooth connection add-on to the Palm in two weeks free to prior purchasers of their monitor [limited time]. You may want to call and get your free connection. This way your palm doesn't have to be connected to your hardware...eliminating the wiring and reducing artifact [According to Jeff at Active]..or if in the future you want to upgrade your Palm.

Author: RobertJ (60.50.252.---)
Date: 06-09-06 06:28

Hi

From browsing the web, I found the site:
<http://www.alivetec.com>
http://www.alivetec.com/pdf/heartmonitor_handout.pdf
It looks like a very interesting ECG monitor.

Regards
Rob

FREEZE FRAMER

The Freeze Framer measures beat to beat heart rate. It samples the rate every 1/2 second. It measures it using a finger (or ear clip) monitor (connected to a computer using a serial or USB interface), so is seeing the pulse wave as it travels through your system. It displays pulse rate vs time. You need to turn off Artifact Detection and HRT Filter (Edit then Options on the General tab, also v1.x only has one of these options). These will mask ectopic beats, so you don't see them.

With a FF, you can:

- 1) get an accurate HR (although if a beat doesn't pump any blood, the monitor won't see it).
- 2) clearly see if you are in AF - the display in AF looks very chaotic as opposed to a normal HR. If you have any question, just get a friend or family member w/o AF and compare. It will be obvious if you are in AF.
- 3) see ectopic beats & therefore compute ectopic counts / hour (or minute).

Following are some examples of FreezeFramer output -

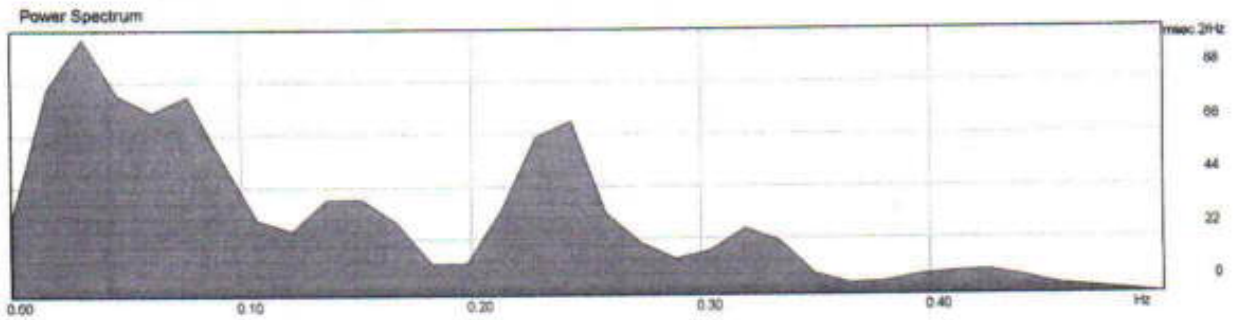
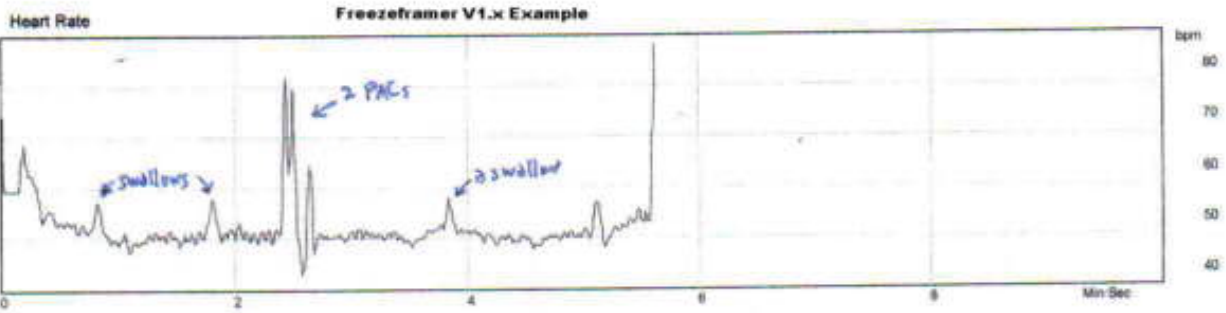
From V 1.X

FREEZE FRAME TRAINER

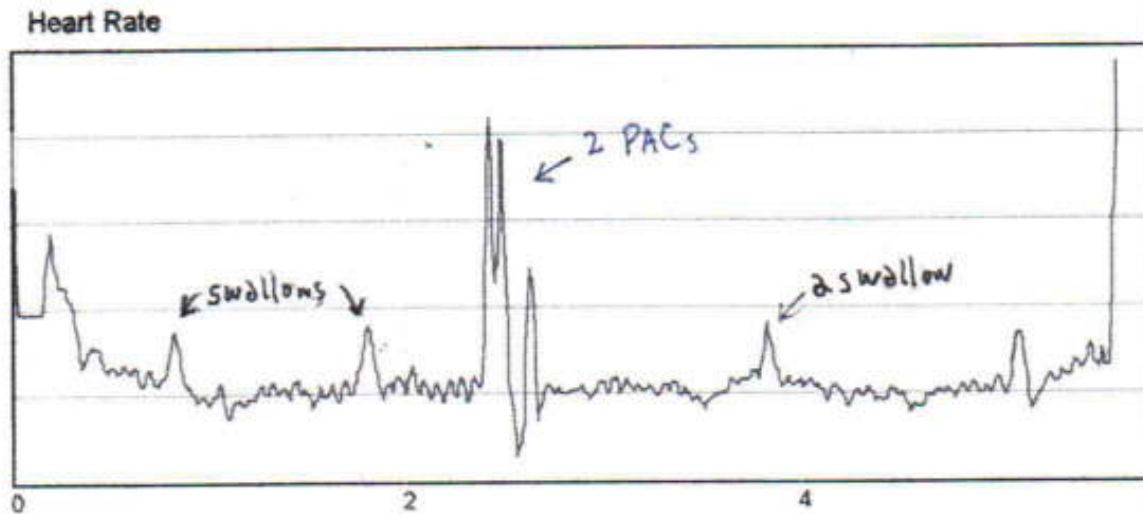
Name : Untitled
Session Date : 05/27/02

Age: N/A

Gender: N/A
Time : 05:07 PM

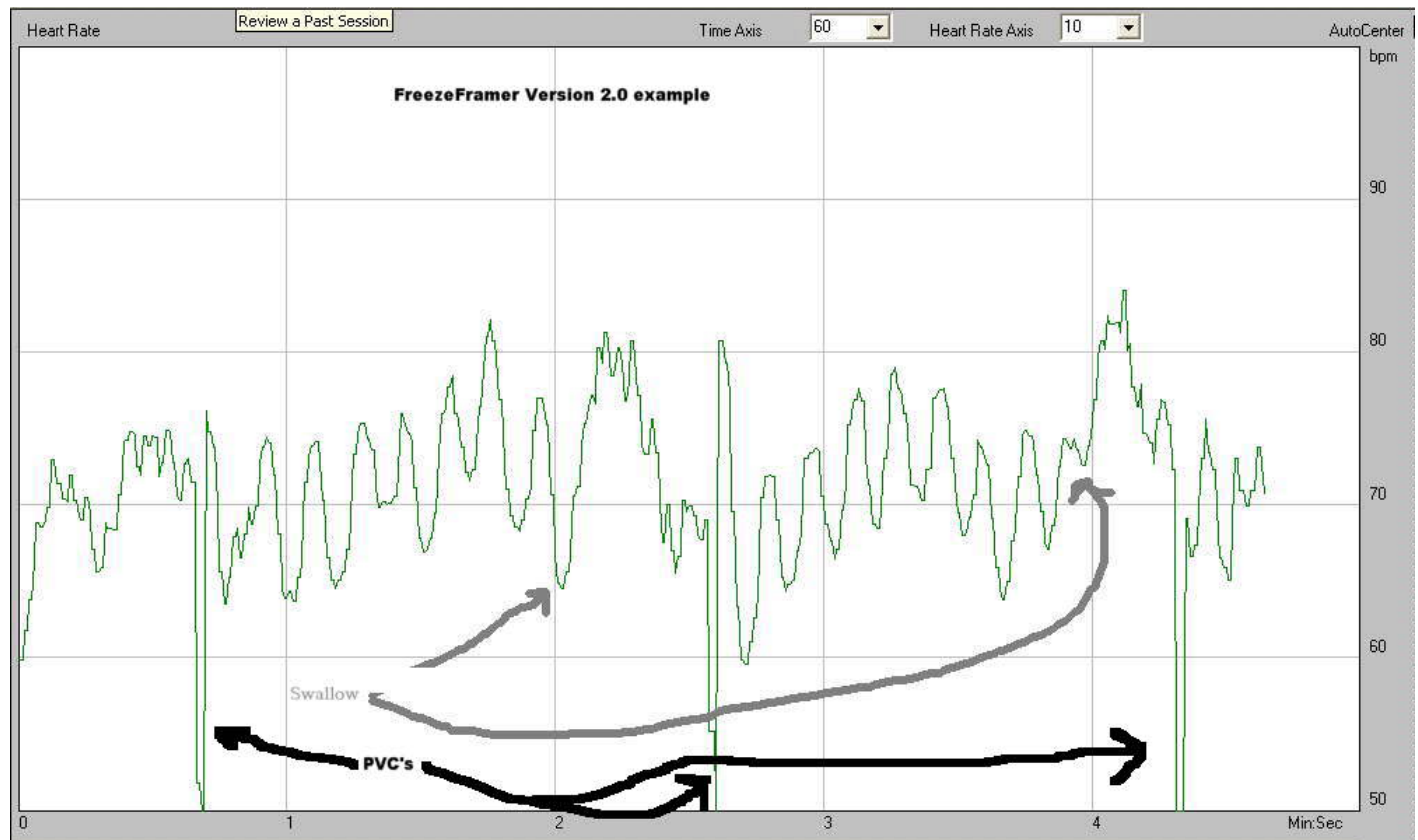


Session Date : 05/27/02



ENLARGEMENT

From V 2.0



The Freeze Framer data can be exported to a text file that can be read by Excel or other programs. It reports the interpolated interbeat intervals in milliseconds every half second. This can be converted into a beat rate using this formula $\text{beat rate} = (1000/\text{interbeat interval}) \times 60$.

Sometimes you can pick up a Freeze Framer (or a Polar S810 or S810(i) on EBAY. Many older models have a serial interface instead of a USB interface. Many new computers only USB interfaces. You can get USB->serial adapters, but they don't always work.

More info on the Freeze Framer is available here:

<http://www.heartmath.com/freezeframer/>

You can purchase one here for \$295 US

<http://www.heartmathstore.com/cgi-bin/category.cgi?item=6002>

Positives - good real time display.

Negatives - must be next to computer, keeping hand with sensor still

I use this when I want a real-time display.

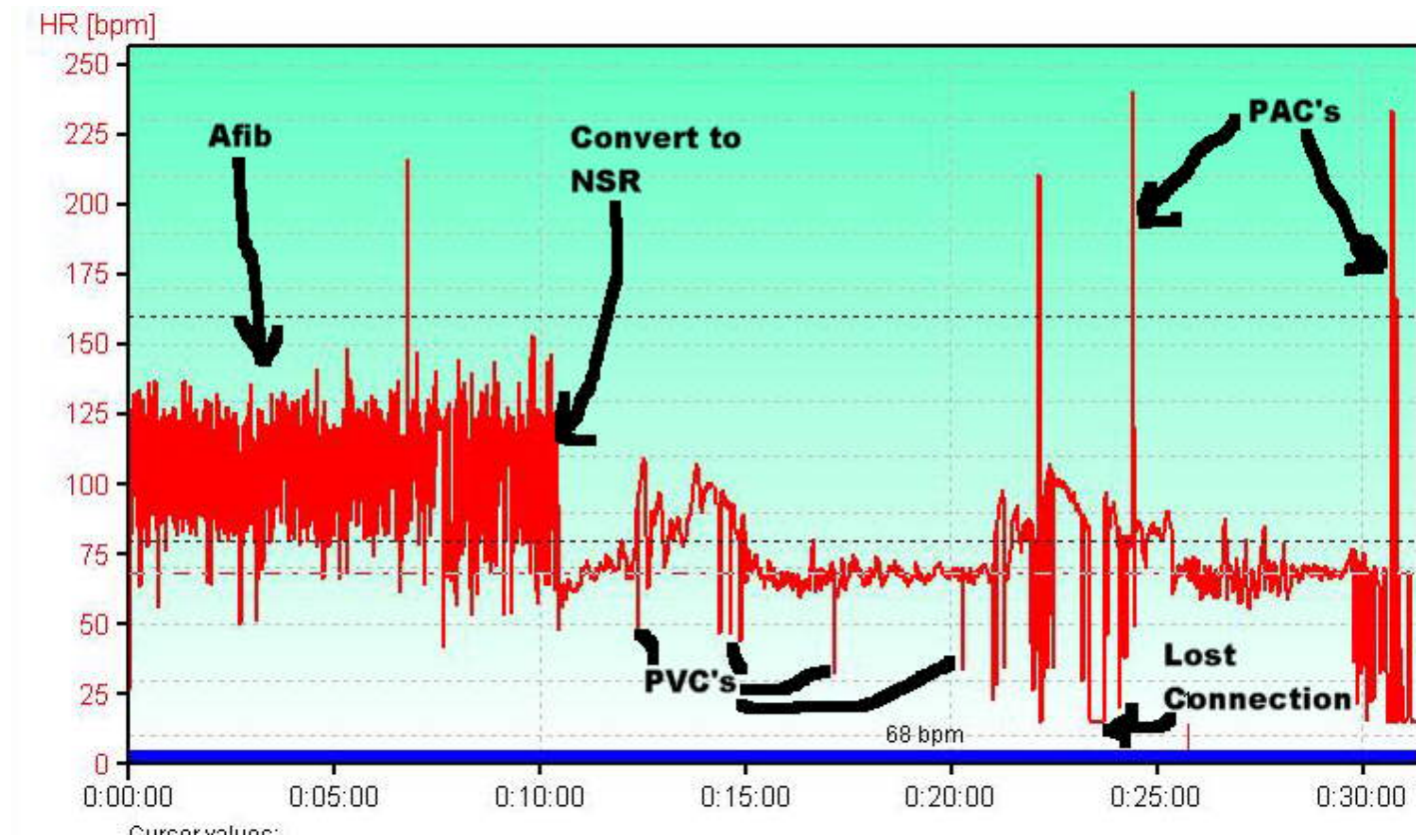
POLAR S810 and S810i

These virtually identical heart rate monitors will record the length of 30,000 beats. This can be uploaded to your computer using a serial or USB infrared interface. It uses a chest strap to sense EKG/ECG signals and transmit these signals to a watch. Every other heart rate monitor will display and/or record a moving average heart rate. This smoothes out the ectopics you are looking for. The S810(i) will show a moving average rate on the watch, but will show

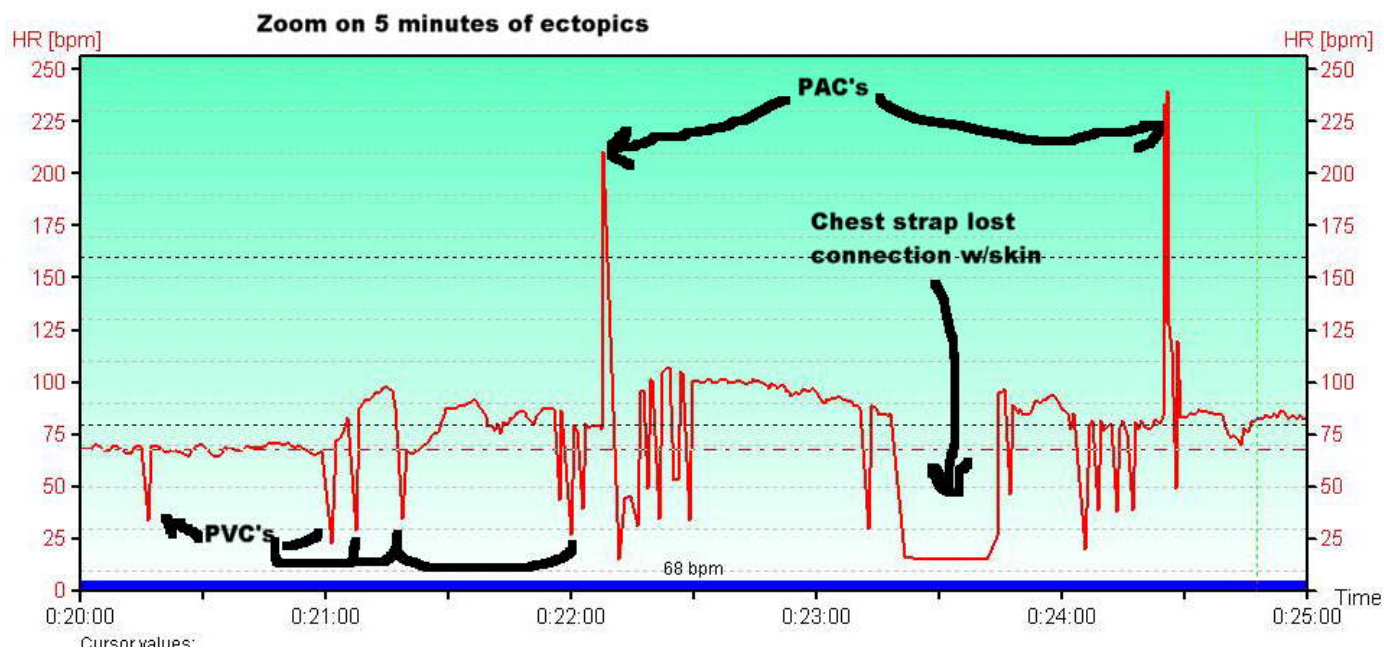
the beat to beat details when uploaded to the included software.

Example output is here:

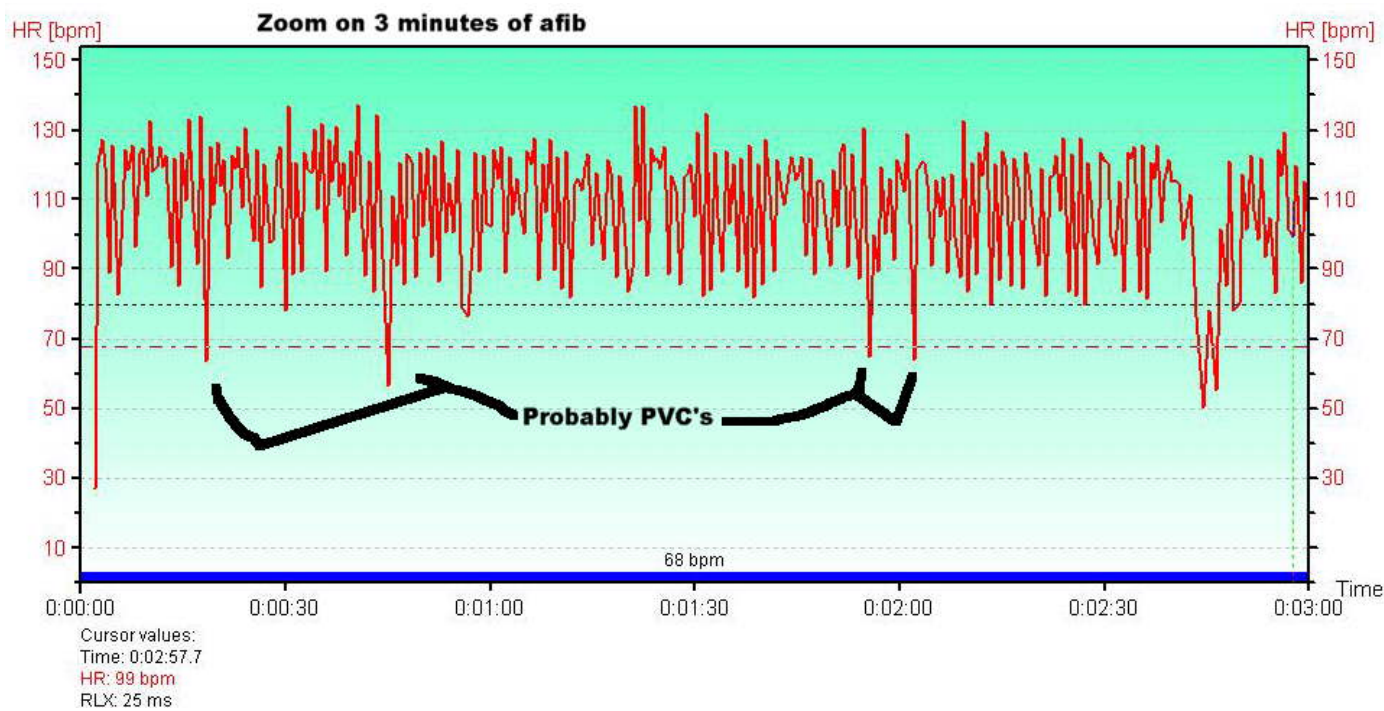
Afib for 11 minutes, then conversion. PVC's & PAC's thereafter.



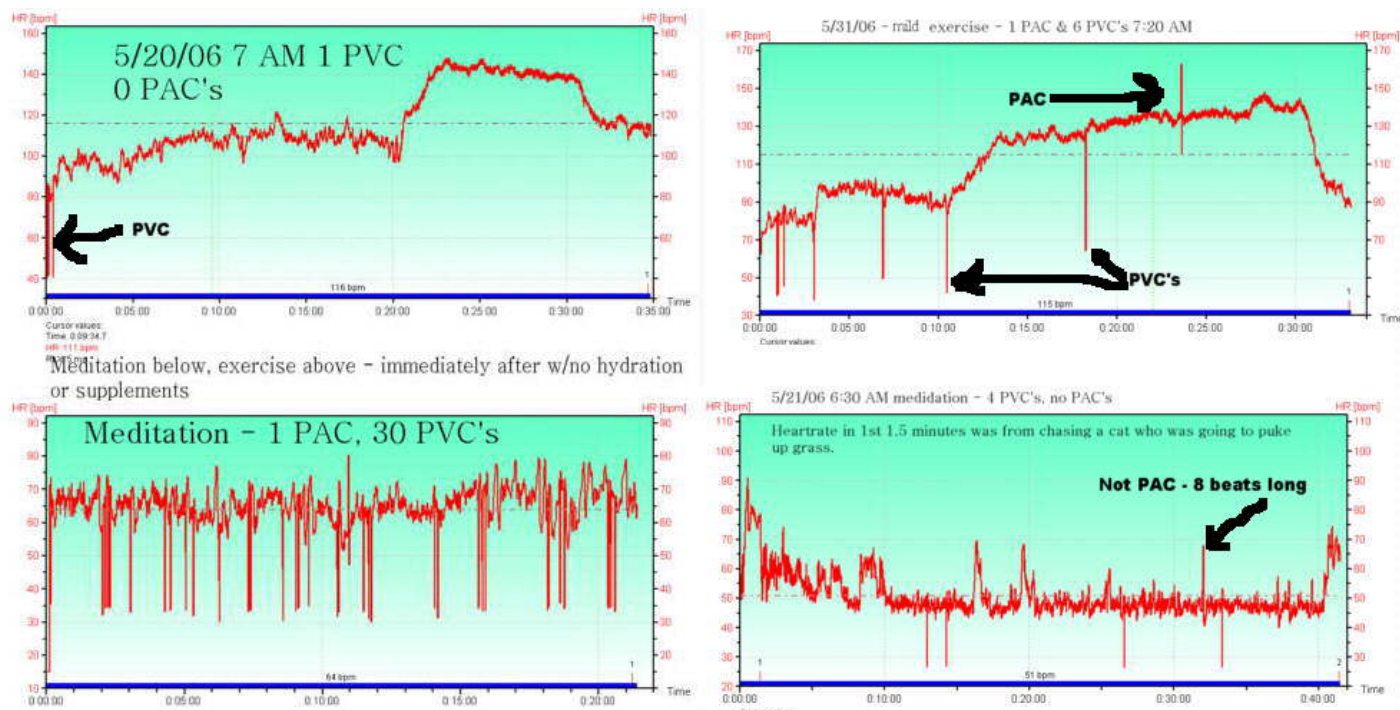
Zoom of PVC's & PAC's, note loss of signal from chest strap at 23:20 minutes.



Zoom of 3 minutes of afib. Note that even afib has some regularity in its chaos.



Here are examples of 2 days of readings. Meditation followed by exercise on each day. Note in the lower right-hand chart what looks like a PAC is not. If zoomed it would be seen to be 8 beats long - 4 up and 4 down. I normally use a 10 minute window so I can differentiate between readings like this and ectopics.



For more information:

<http://www.polar.fi/polar/channels/eng/segments/products/S810i.html>

The S810i can be purchased at many web and local shops. I believe it retails for around \$400 US. If you get it, make sure you also get the infrared interface to communicate with the computer. It is about \$40 US separately. I bought mine from EBAY, used.

This is my most used monitor. I mostly use it to get ectopic counts. Its drawback is that you can get artefacts in the data. Sometimes the monitor will show a false ~230 BPM reading if the chest strap doesn't have a good connection. You can also get 0 BPM readings.

Polar & Freeze Framer Interpretation

Here is an edited version of some previous posts on interpreting PVC's & PAC's on the Polar or FreezeFramer & also minimizing artefacts.

As to the radial pulse not showing what the atria are doing. This is true, however, if the atria are fibrillating, there is normally much greater variability in the ventricular rate. I've used a finger pulse monitor (Freeze Framer - which "sees" the pulse wave in the finger), an r to r recording exercise heart rate monitor (Polar S810i which sees the ECG electrical activity of the heart), an ECG monitor, a stethoscope as well as my finger on a pulse point to monitor PVC's, PAC's & AF.

AF in me on either of the HR monitors is unmistakable. The beat to beat variability is enormously greater than normal

beat to beat variances. The relatively large normal variance was unknown to me until I started using these monitors. This normal variance is too small to be felt with the finger. However the AF variance is large enough to be felt.

Another interesting observation was that PAC's & PVC's had different signatures, but these signatures were duplicated in the pulse HR monitor and the ECG HR monitor. This was true, even though they were measuring something completely different. PVC's had a "slow" beat signature at 1/2 the rate and twice the length of "normal" beats. I learned that this is because the ECG HR monitor (S810i) did not "see" the abnormal QRS wave of the PVC beat. With the radial pulse meter (FreezeFramer), the abnormal PVC beat did not pump any blood, therefore it did not "see" this beat either. I could also feel or hear this "skip" with my finger or a stethoscope, respectively. With the finger, it was followed by a "hard" beat. This can sometimes be felt in the throat of PVC sufferers. However, I almost never feel an ectopic beat, even though I have 10-20 PVC's and 2 PAC's/hour.

As to PAC's, on both HR monitors, they show as a "quick" beat or a "quick" followed by a "slow" beat. I can also feel/hear this with my finger or a stethoscope.

At one time, I simultaneously hooked up an ECG monitor, as well as the ECG and fingertip HR monitors. There was a 1 to 1 correlation with the appropriate ECG waveforms for PAC's and PVC's with the HR signatures described above.

My point in all of this is that even for someone who is asymptomatic (me), one can ascertain quite a bit with just your finger, or better yet a stethoscope.

The Polar does have a real time display mode, however it seems to report a moving average rate instead of the r to r rate

Here are some suggestions for minimizing the errors from the Polar from another website:

Suggestions for Using the Exercise Heart Rate Monitor

Here are some tips to insure successful data collection with the Exercise Heart Rate Monitor:

0. Polar suggests using ECG gel with your strap in R to R mode.

1. Make sure that the belt fits snugly around the chest and is resting directly against the subject's skin. You may need to reposition the transmitter left or right, or place it lower or higher. Make sure to re-wet the electrodes each time the belt is repositioned.

2. Use plenty of saline solution to wet the electrodes.

3. Be sure to hold the receiver within 80 cm of the transmitter belt. This is the maximum transmission range of the transmitter in the chest belt.

4. The receiver of the Exercise Heart Rate Monitor will receive signals from other transmitter belts if they are within range; be sure to maintain a distance of at least 2 meters between individuals that are wearing this sensor (not true for the 810's coded strap).

5. Interference from other electrical devices, such as computer monitors and electronic exercise equipment (treadmills, stationary bicycles, etc.), can result in poor readings. Other equipment that may interfere with the EHR signal include televisions, cars, cellphones, TV antennas, and high voltage power lines (both above and below ground). Keep the receiver of the Exercise Heart Rate Monitor as far away as possible from such equipment.

6. Static electricity in clothing or a flapping shirt can cause electrical interference, so some items of clothing (i.e. man-made fibers) can also cause unusual readings.

7. Dirty electrodes can cause poor readings. Wash the transmitter regularly after use with a mild soap and water solution. Dry carefully with a soft towel after washing. Do not use alcohol or a solvent based detergent.

Source: <http://www2.vernier.com/booklets/ehr.pdf> - page 3

George N.

Nice job, Sherlock.

PC

George: Re the FreezeFramer: They offer an ear clip sensor for about \$25 that gives much more steady data than the finger clip. You have a lot more freedom of movement with it.

Gordon

Hi Gordon,

I'm glad to hear that the ear clip is better. I have an early V 2.0 program with a serial finger sensor and unfortunately would have to purchase the USB Pod Interface Device (\$125) in addition to upgrade to the ear clip.

Aloha PC,

Thanks for the compliment. Perhaps you and Wil could describe your Holter testing and what you've learned.

George

Regarding the stethoscope thread, that was a great trip down memory lane for me! What great info I was given. I was somewhat new to this board back then.

I currently use a stethoscope regularly. It has been extremely helpful in distinguishing afib from NSR. The lub dub of NSR is definitely a solid clear and steady sound compared to afib. I think some of my perceived increase in afib episodes is due to an increase in my detection ability with the stethoscope.

Per George's request here's some purchase info. I bought a kit that contained a stethoscope and blood pressure monitor, Match Mates 01-360-211 Sphygmomanometer Sprague Kit-Royal Blue, from Amazon.com for \$26.99 .
http://www.amazon.com/gp/product/B0000AOWP4/qid=1150911399/sr=1-1/ref=sr_1_1/103-9251353-1672647?%5Fencoding=UTF8&s=hpc&v=glance&n=3760901 .

I think that the stethoscope alone costs \$10.85 but I'm not sure it's the same one.
http://www.amazon.com/gp/product/B000FERLKS/qid=1150912278/sr=1-3/ref=sr_1_3/103-9251353-1672647?%5Fencoding=UTF8&s=hpc&v=glance&n=3760901

It is my understanding that the ones with two tubes going all the way down to the head (the part you press to your chest) are better than the single tube type.

I first looked for a stethoscope at several major drugstores in Orange County CA and they didn't have any.

Bob K.

George,

What a great job. Very, very interesting information. It was fun to compare my FreezeFramer graphs with yours. How about posting some heart rate variability graphs as well?

We'll do the .pdf file very soon so people can see the illustrations without having to click on the links.

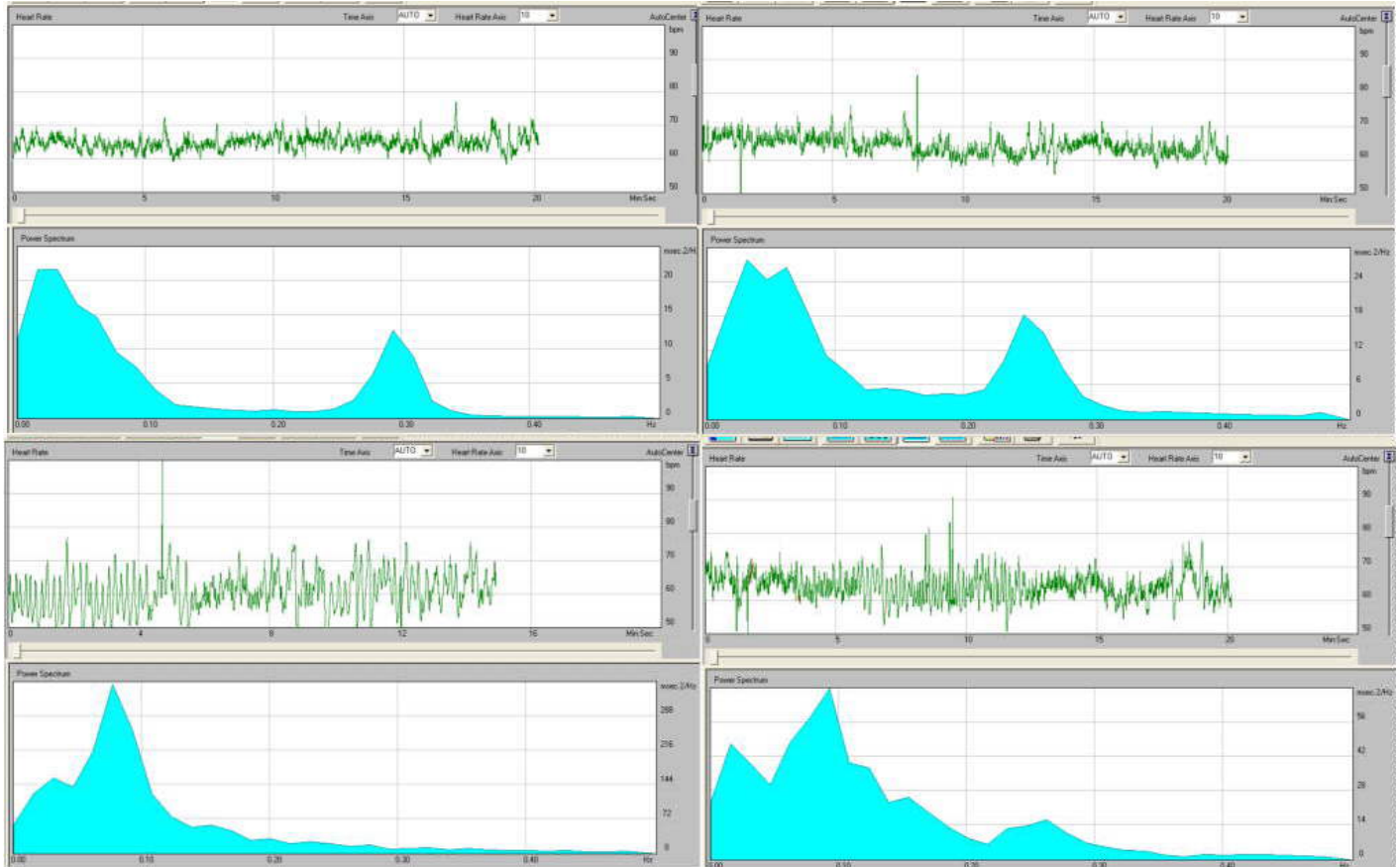
Hans

Hi Hans,

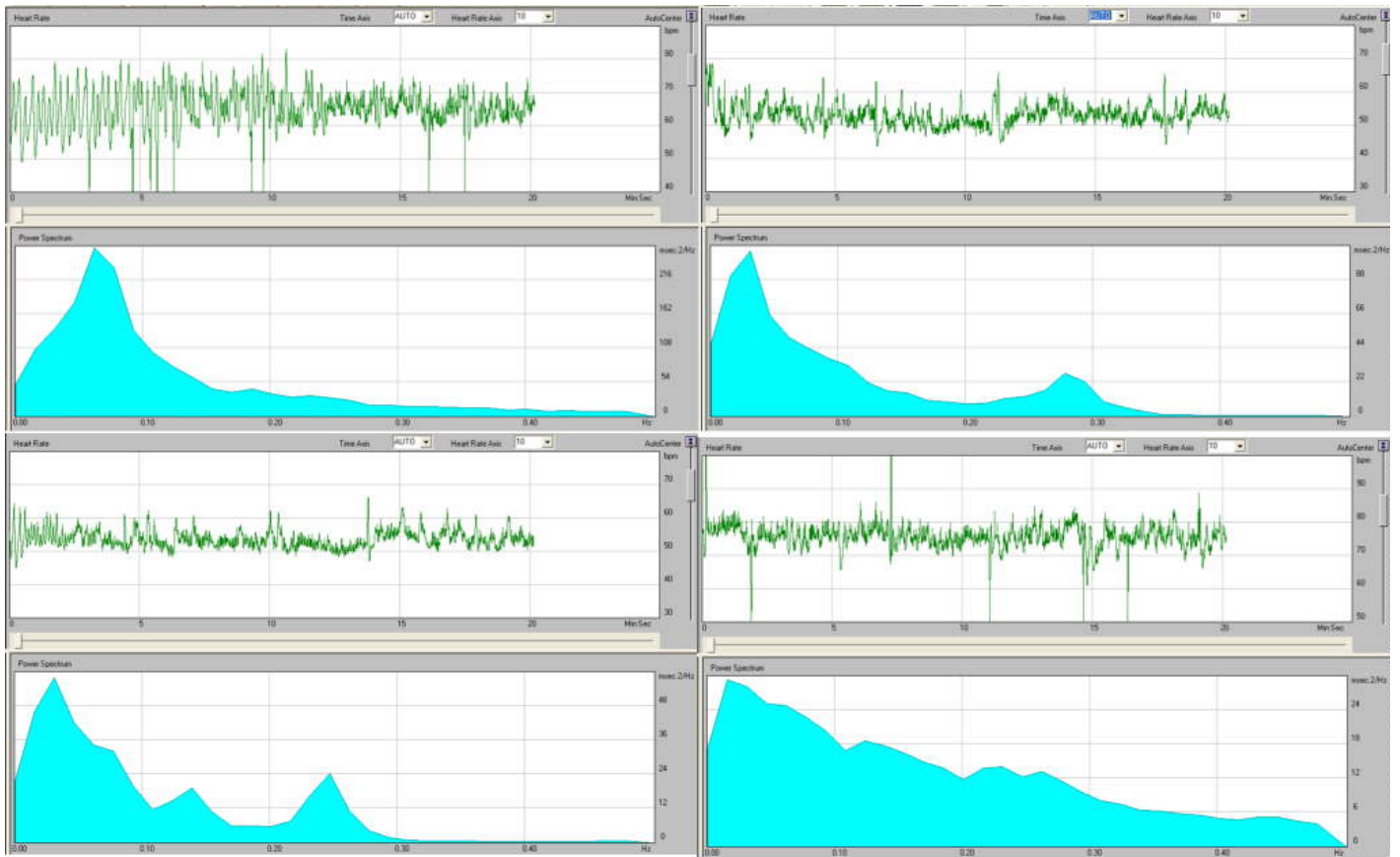
Thank you for the compliments.

Here are some HRV graphs you requested. I found that I could change the HRV output with 6 second in, 6 second out breathing. For those who are not familiar, the bottom of each graph is Power Spectrum output of the HR frequency in Hz. You can use this to see changes in vagal and sympathetic tone relationships, though there is some debate about this. I will spare you the details.

In the bottom two graphs in this file, I was playing the breathing game a bit. The upper left is a clean run - no ectopics, in the upper right there is one PVC and one PAC. In the lower right there are 4-5 PAC's and 3 PVC's.



The upper left there is nine PVC's and one PAC, in the upper right there is one PAC. In the lower left there are 2 PAC's. In the lower right there are 2 PAC's and 4 PVC's.



Thanks to Bob K. for the live link reminder.

George

George

As you know, I have only had my Polar S810i for a couple of weeks but it was invaluable to tell me when I entered AF and also when I left. I will email you some HRM files with some notes that maybe useful. I was considering writing up my experiences in a PDF document and sending them for comments but this conference is a great idea.

Note that you do not need to buy the Infrared interface (and therefore save around \$40) if your PC already supports this interface. Most modern laptops come with an infrared port.

I tend to wear my Polar most of the time - maybe I am like a kid with a new toy - but I have been switching into AF quite often recently. Normally around 8hrs of data can be gathered but in AF, this could be as low as 3hrs. I always start a new data gathering session just before going to bed. In the morning, I upload the data to my laptop. I then start another session during the day and upload this around 6pm. I then do another session in the evening. If I can use this info to help determine times of AF, PACs, PVCs then maybe I can identify my triggers. I will reduce my monitoring when I get AF under better management.

I do copy the graphs to my AF diary (word doc) for future reference. My cardiologist was interested in the graphs but still a little bit sceptical. However my intent is to show him how the graphs/data can help us better understand my AF condition.

As you mention, artefacts (strange readings) can occur for many reasons e.g. moving, car, TV. I would add a

PC/Laptop to the list especially if you have a CD/DVD in the drive.

I think it would be good if there was a way to 'set' an indicator while collecting data during an 'exercise'. For example, if you feel some ectopic beats, is there a way to click on one of the Polar buttons and see this indicator in the graph? Maybe use the lap timer? I have yet to explore this.

It would be an interesting exercise to write a program that can read the HRM files and produce a report that indicates exceptions to normal HR. This could be used to provide some candidate times/data for PACs, PVCs and AF. If I get time, I will see if this is feasible.

Can I suggest we prepare some notes for the non technical people about how to load upload the data in the wrist unit, how to select data (exercise/HRM files), how to display the graph, how to 'zoom' in on the data. Maybe this is a secondary exercise to this conference.

Once again this conference is a great idea.

Regards

Rob

I send Activetec an email and got this reply:

"We have a big backlog of orders and a number of clinical research projects on the go at the moment so we are not really in a position to involve you at the moment but this will change in the next few months once we get further products approvals and expand our production. We don't have any trials looking specifically at home monitoring of AF so your email has been very valuable in highlighting the need for this.

If they contact me again, I will update the BB.

Rob

Rob,

"Can I suggest we prepare some notes for the non technical people about how to load upload the data in the wrist unit, how to select data (exercise/HRM files), how to display the graph, how to 'zoom' in on the data. Maybe this is a secondary exercise to this conference."

I think this is a perfect place to do this & would welcome you putting something together. One benefit of the conference room (CR) is that it gathers a lot of information together in one spot - people don't have to search for it.

"Maybe use the lap timer? "

Yes this is a good idea. I'll do it. It will show up with a little (lap) number on the display.

". Most modern laptops come with an infrared port." Not my six month old hp. My old Win 95 laptop did, but I didn't have luck with it. It worked with the serial IR though.

"I will email you some HRM files with some notes that maybe useful." What would be helpful would be for you to do a screen capture(s) of what you are interested in, annotate that & write it up. If you email that to me, I will post the graphics and put in the references to them into the text & post it to the CR.

Thanks for your input.

George

Has anyone experience of the wrist type digital blood pressure monitors that can download stored information into the PC?

I bought a wrist monitor a month ago and am very happy with it as it can store BP & HR and Date/Time stamp for 3 times 30 readings. I am not so happy however to key in this information into a spread-sheet to get a graphic presentation.

As I have written many times before I have a problem with a dysfunctional endothelium, which in the end is triggering AF when the load of the heart becomes too high. This happens usually when I am asleep with low pulse.

I have tried to document have I react to exercise when I warm up and think I can see abnormalities there. It is a matter of when the NO production in the arteries kicks in.

I take a bike ride and use the wrist device every 5th minutes or so. I have also documented how I react to a Cialis pill when I wake up with ectopic beats in the morning.

It would sure be easier if I could unload the data into the computer. So again: Has anyone got experience with these devices and the software?

Gunnar

Hi Robert,

Regarding your query

"if you feel some ectopic beats, is there a way to click on one of the Polar buttons and see this indicator in the graph? Maybe use the lap timer? I have yet to explore this."

you're quite right. You can use the red button as an event monitor. At the bottom of the downloaded recording you will see a slash mark indicating this.

However, I found the most useful feature of the S810 to be the RLX (=HRV). I could always tell, even in the absence of PACs, when I was at risk.

PC

PC,

Was this when the RLX was high ~ indicating high vagal tone? I know that I can change this just with my breathing so wonder about its correlation w/afib. It obviously also goes down w/exercise.

George

George,

During the last two years of my struggles with AF after episodes expanded from strictly middle of the night stuff that terminated shortly after arising I noticed a distinct correlation between inappropriately low RLX, while playing golf or other orthostatic challenge, and subsequent rebound after sitting down and relaxing afterward. The latter of course was the at-risk period, but I knew way in advance that trouble was brewing. I think the problem was extra aldosterone and angiotensin elicited during the orthostatic challenge. Both of these are vagolytic and rigorous hydration was helpful but no guarantee.

PC

PC

Thanks for the valuable comments. I can see the Rlx values displayed at the top of the monitor when scrolling thru the screens on the wrist unit. I also set the curve advance option to display the Rlx for the cursor position.

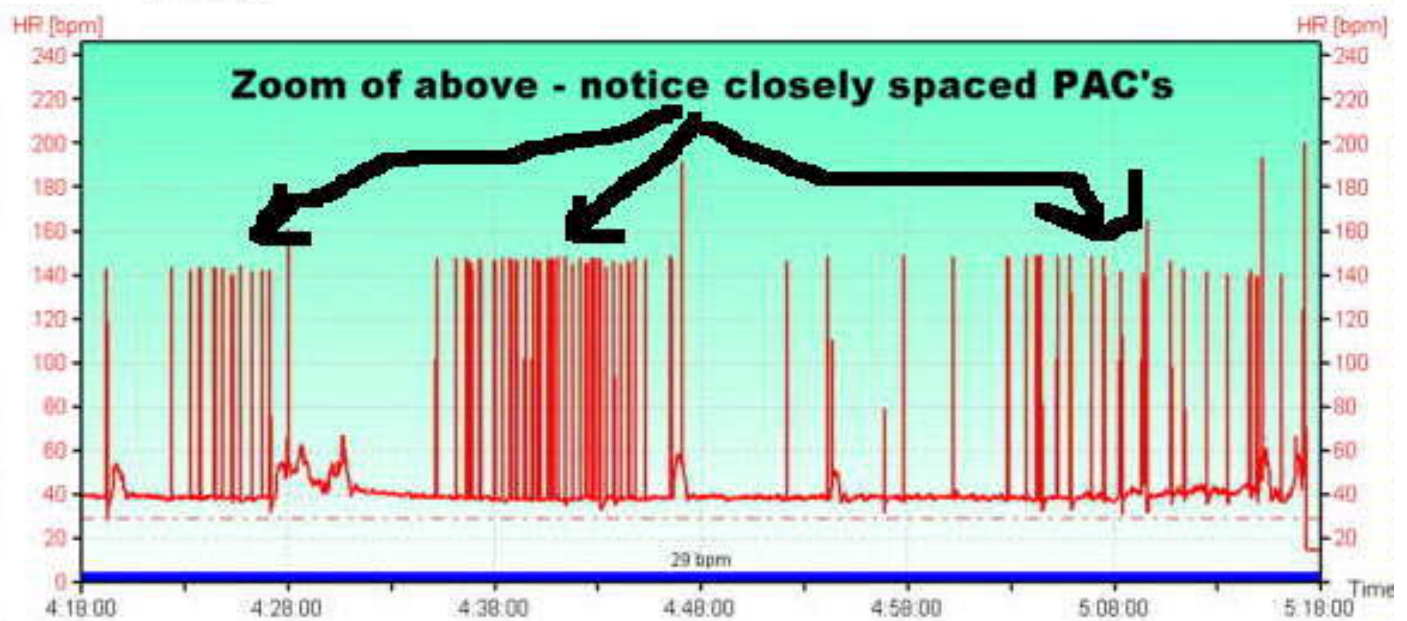
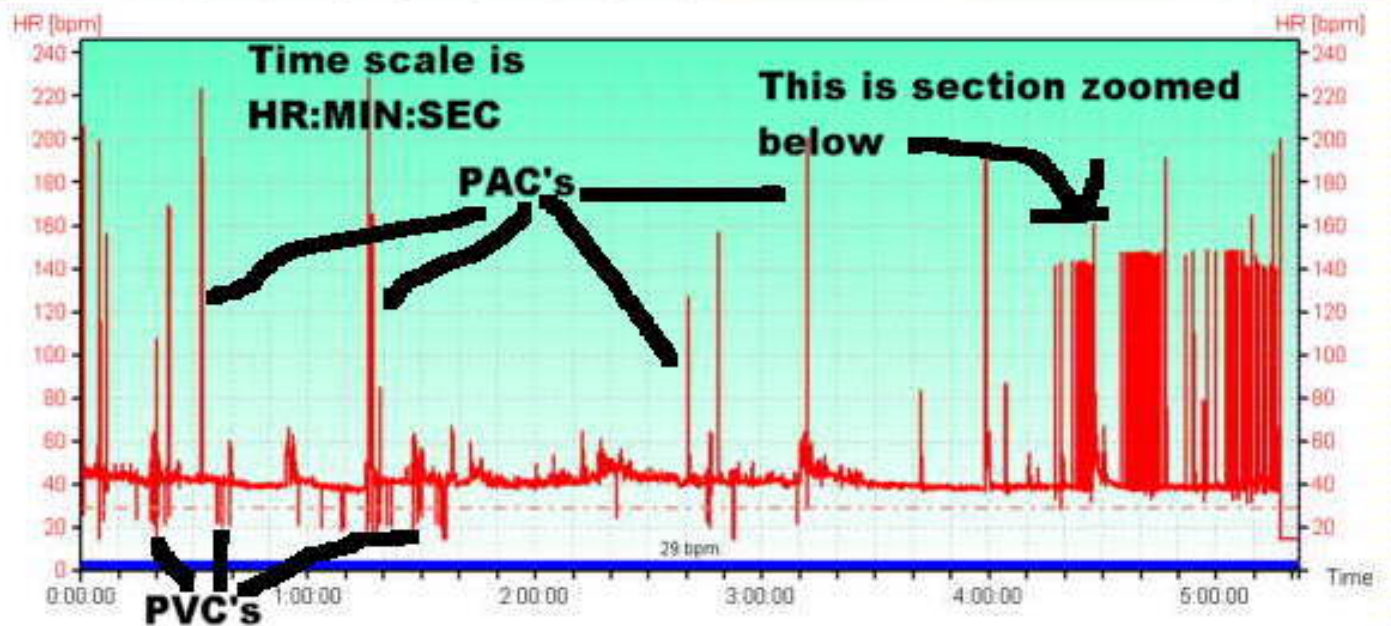
My last AF episode began at night (around 5am). If I was monitoring with the Polar, would I be able to tell from the graph the risk periods? (I would envisage sometimes wearing the Polar during meetings etc where I would not be able to frequently monitor the wrist display.) My resting Rlx appears to be around 25ms. What would be an indication of a risk period? The Polar s/w defaults to 50ms as the Prolongation Interval but it can be set to other values. Can the S810 be set to 'beep' when the Rlx variation exceeds some limit? (I couldn't find this in the manual during a brief read.)

Rob

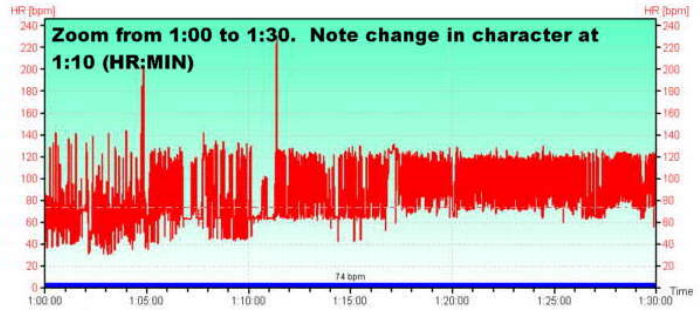
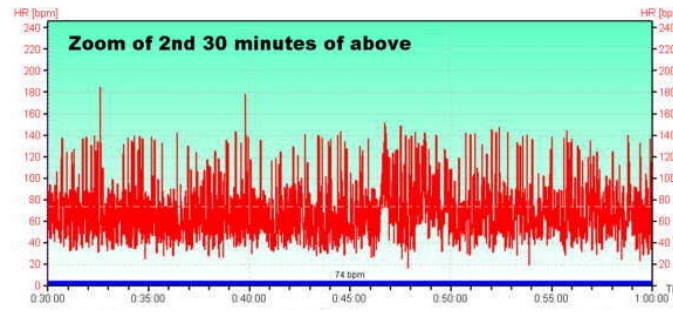
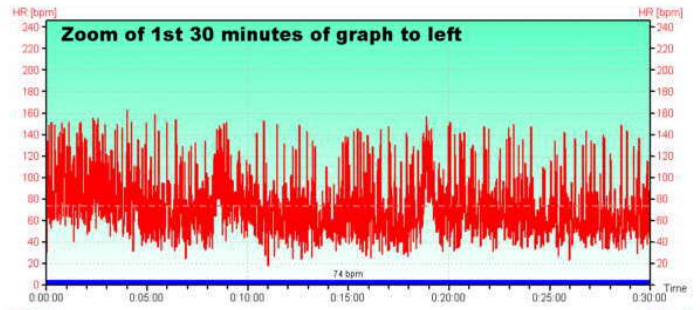
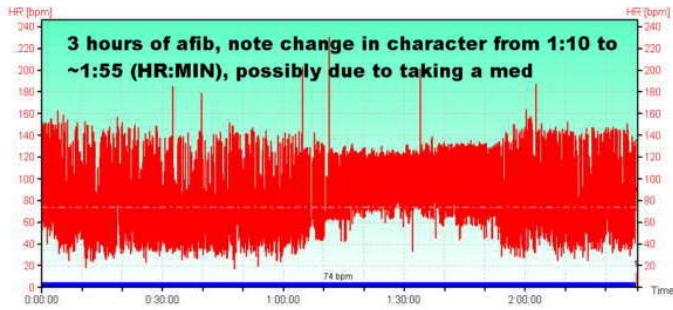
Hi,

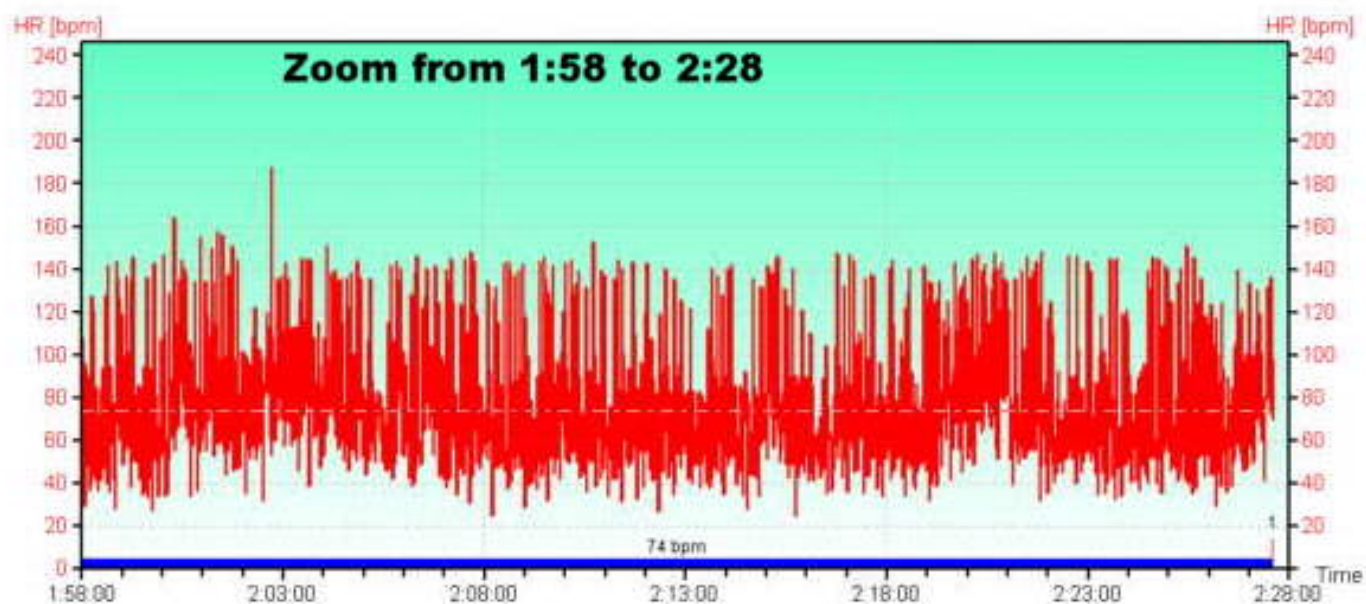
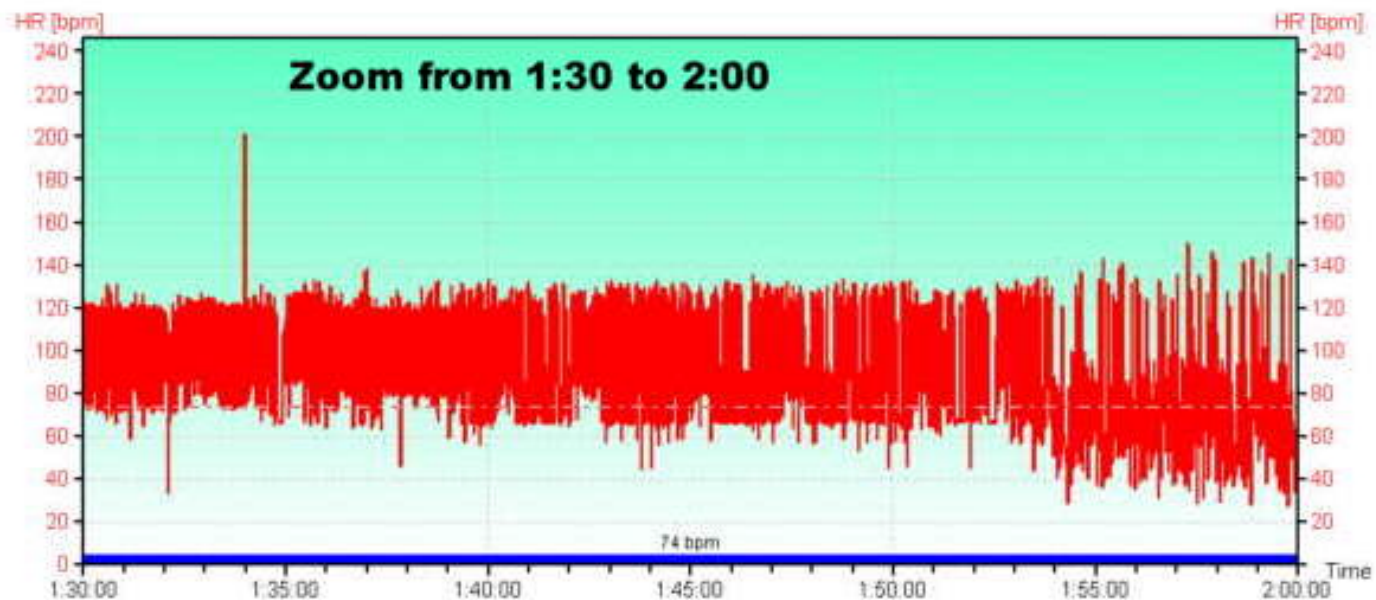
Rob kindly sent me some Polar S810i files which I've made into jpegs and annotated. Unfortunately his explanatory email is archived on my office computer & I'm writing this at home, so I'll let Rob expand on the explanations. I should also note, for Rob's benefit that I've changed the X-axis from clock time to elapsed time.

This shows about 5 hours of sleep, till the chest strap lost contact. It starts at about 11 PM. Notice a lot of PAC's about 3:30AM - 4 hours & 20 minutes after starting. Rob said his girlfriend said he was snoring loudly. The zoom on bottom shows a lot of closely spaced PAC's.

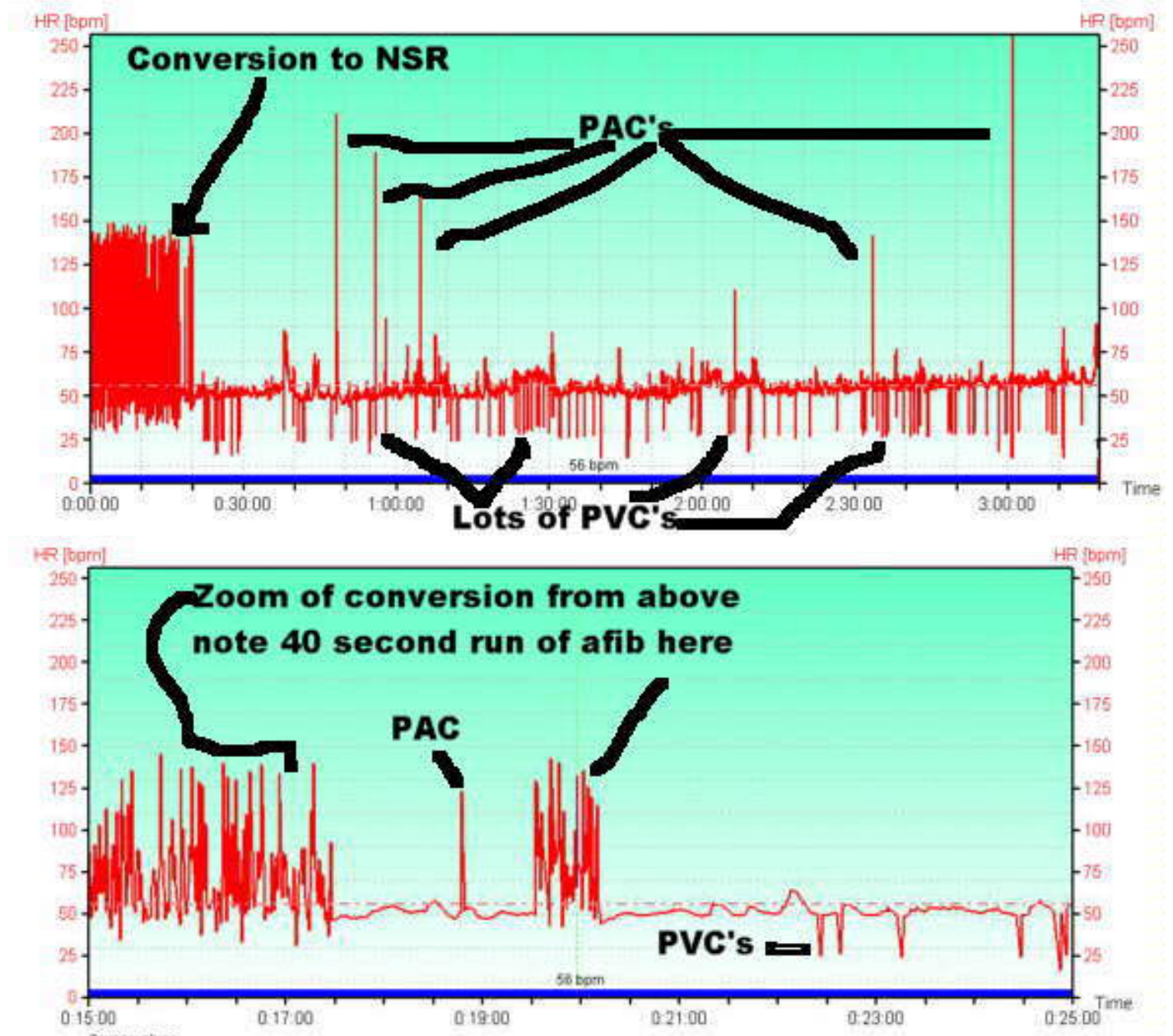


The upper left graph shows about 3 hours of afib. Note the change in character at 1:10. The other 3 graphs are 30-minute zooms of the afib, the second file are two more 30 minute zooms.





This shows the conversion to NSR from a 130-hour afib session. Note the short run of afib after conversion. The bottom graph is a zoom of the conversion. Notice that he still had a lot of PAC's & PVC's after conversion.



George

Hi PC,

Do you know how they compute RLX? I know in the software you can see RLX values for each beat, but it would be nice to see a graph of RLX along with the beat rate values. We might learn something here. If you don't, I suppose we could contact Polar.

George

George,

I already asked them that question and below was their answer.

"RLX is a modified unit of heart rate variation of SD1 which is calculated from beat to beat differences in R-R intervals. So basically they are measuring the same thing. SD1 is very close to rMSSD, root mean square of the differences between succeeding R-R intervals. It reflects the parasympathetic activity directed to heart via autonomic nervous system. Parasympathetic activity is strong at rest, and it is especially strong in young athletes. Parasympathetic activity slows heart rate."

So, the RLX gives you live feedback on autonomic tone. If you go to the polar software and open a file that contains the start of an AF episode and then go to View/Active View Properties/Advanced and then check the RLX box, you can then follow your RLX beat for beat as you approach the beginning of the episode. Just place your cursor below the graph and hold down the left click of your mouse and move the cursor to your right.

PC

Robert,

You seem to have mastered accessing the RLX data from your recordings (see below post to George). The answer to your question about the indication of the at-risk period is the RLX values as you approach the beginning of an episode. Once you know this then you'll begin to get a sense of when you are at risk, as you follow your RLX in real time. Your increasing PACs should mirror this increase in RLX.

PC

Firstly thanks to George for converting my .hrm files into .jpgs with some annotations. The series of graphs shows the progression of a 130 hr AF episode for me. As can be seen the AF episode started sometime in the early morning.

At 11:30pm, I went to bed but could not sleep due to sore legs (thighs and calves were sore but not a muscular soreness). I got up at 12:30am as walking and sitting helped decrease the leg pain. At 1am my BP was 102/59. I went back to bed at 2:30am. As mentioned, I apparently snored a lot and was restless with many visits to the toilet to urinate. The Polar was very useful to track the AF process.

uROB1 shows a few series of a lot of PACs in a very short period. At the time my HR was averaging below 40 bpm. My BP was probably lower than the measurement at 1am. Note that low HR and BP are a bad combination especially if other triggers are present. In my case, this might have been over tired and hypoglycemia. I think uROB1 shows the start of the AF because I awoke at 9:50am in AF.

uROB2 shows the affect of a loading dose of Rythmol while in hospital. My medication was changed from Sotalol to Rythmol and Verapamil. It is interesting to note how my HR, while still variable, becomes somewhat 'regular' instead of irregular. I am unsure if this indicates flutter. I am unsure why this occurred. Could it indicate the heart trying to get into NSR? uROB3 shows the HR variation more concentrated to the low end of the 'fibrillation' range.

Finally uROB4 shows the conversion from AF to NSR. Even after the initial conversion, another small AF episode occurred before NSR. At time of writing, I have been AF free for over 5 days.

So the benefits of the Polar HRM in this case have been:

1. clearly show the initiation of the AF period (or slightly before it).
2. how your heart behaves during AF and reaction to different medications
3. conversion back to NSR
4. the fact that I experience a lot of ectopic beats

These findings have identified that my AF is caused by a combination of triggers including low HR/BP, overtiredness

and possibly a sleep disorder.

BTW my cardiologist was impressed when I was able to tell him exactly when I convert to NSR plus he had a good look at the graphs.

Rob

PC

I checked the .hrm file for my last AF and noticed the RLX was between 15-20ms for the PACs shown in uROB1. However I looked at another .HRM file from last night and I had a few series of multiple PACs. For some, the RLX averaged around 75ms while for another it averaged 130ms. So a low RLX value seems to be the trigger but why the variation in RLX with different sets of PACs?

It would be better if the RLX could be plotted as another data series on the graph. Then it can be captured in a jpeg etc for later comparison.

Rob

Robert,

The RLX increases with PACs only because PACs are irregular beats and as such introduce more variability in the R-R intervals. Watch your real time RLX and notice how it will increase about 5 seconds after experiencing PACs.

What you want to evaluate is your PAC free RLX in the time preceding your episodes of AF. Right before the episode has too many PACs usually and you want to look at least 10-20 minutes before.

This will not be particularly helpful if your episodes only occur at night, but if they occur during the day, you might be able to ward off the episode with judicious potassium. For some this may not work, but it's worth a try.

PC

Many Afibbers begin an AF episode while they are asleep as in my example above. In my case the previous two nights, I had slept very peacefully and did not snore or toss & turn as on the night of my attack. So can we use a heart rate monitor like the Polar S810i indicate sleep apnea and other sleep disorders?

ArtSD posted the following notes on this topic in the BB:

=====

There has been some discussion on sleep apnea and afib. At this point in my journey, post-ablation, flecainide, and Pac-Tamer, I am not being afflicted. But I thought I would show some interesting plots of what is going on with the heart during (my) apnea.

A heart rate monitor is one method to document sleep apnea. I found a paper, "Detection of Obstructive Sleep Apnea from Cardiac Interbeat Interval Time Series", at the PhysioToolkit site, that matched up with my sleep pattern quite well.

The following extracted plots show a cyclic pattern of approx. 24-second period of blockage, recovery, and repeat.

Two hours of sleep with almost all showing obstructive sleep apnea

<http://members.cox.net/genebeme/photogallery/heart/SleepApneaFull.jpg>

Zoom of 5 minutes of sleep apnea

<http://members.cox.net/genebeme/photogallery/heart/SleepApneaZoom.jpg>

The url to the article is:

<http://www.physionet.org/physiotools/apdet/apdet.shtml>

Rob

Robert,

You and Art may find the below article stimulating.

Sleep Apnea -- A New Approach?

<http://www.healthandage.com/PHome/115!gm=2!gid2=1760>

It implicates increased vagal tone in the genesis of sleep apnea. Accordingly you might find the RLX data on nocturnal Polar recordings before episodes of AF elucidating.

PC

Interesting - Stimulatory. Have a cup of hot chocolate or coffee at bedtime.... :) just kidding.

Theophylline:

Theophylline and its close relatives aminophylline, caffeine and chocolate, are members of the methylxanthine group of chemicals.

SIDE EFFECTS

The negative side effects of theophylline include: restlessness/caffeine type jitters (this can be minimized by starting the medication at a lower dose and gradually increasing to the recommended dose), diuretic effect (some individuals only), upset stomach, racing heart rate with abnormal rhythm.

http://www.marvistavet.com/html/body_theophylline.html

Jackie

Instead of lowering vagal tone, how about increasing sympathetic tone. Gunnar has reported benefit from Cialis (see http://www.afibbers.net/forum/read.php?f=4&i=11077&t=10997#reply_11077), hypothesizing that this benefit is from increased NO:

Sympathetic activation by sildenafil. <http://circ.ahajournals.org/cgi/content/full/104/22/e119>

Phillips BG, Kato M, Pesek CA, et al. Sympathetic activation by sildenafil. Circulation. 2000;102:3068–3073.

George

Hi George,

For me it is not a matter of increasing sympathetic tone. It is reducing the diastolic pressure.

I have got a cold which has raised my BP and last night I woke up with lots of ectopic beats and on my way into Afib. I have reduced my intake of Cialis to 1 pill every week or every other week since April due to the positive effect of L-Arginine.

Note in the article you posted it was as usual healthy young men and not grumpy old men with a possible dysfunctional endothelium that were tested.

Anyway this time I used my wrist digital BP meter and followed the pressure after taking a pill. It is amazing to see how

the diastolic pressure goes down. I have seen it go down even faster but that was after a pill in the morning on an empty stomach. The ectopic beats will stop within 15 minutes.

This is my way to stay out of Afib. Have I explained the beauty of the auto regulation that takes place due shear stress on the artery lining which will induce produce NO and in the end block Ca^{++} in the smooth muscle in a way that is understandable? Ca^{++} blocking on demand.

I could key-in the values into an Excel spread and post it to you if you would be so kind and post it on your site. I do not know how to post anything on a website.

Gunnar

Thanks Gunnar,

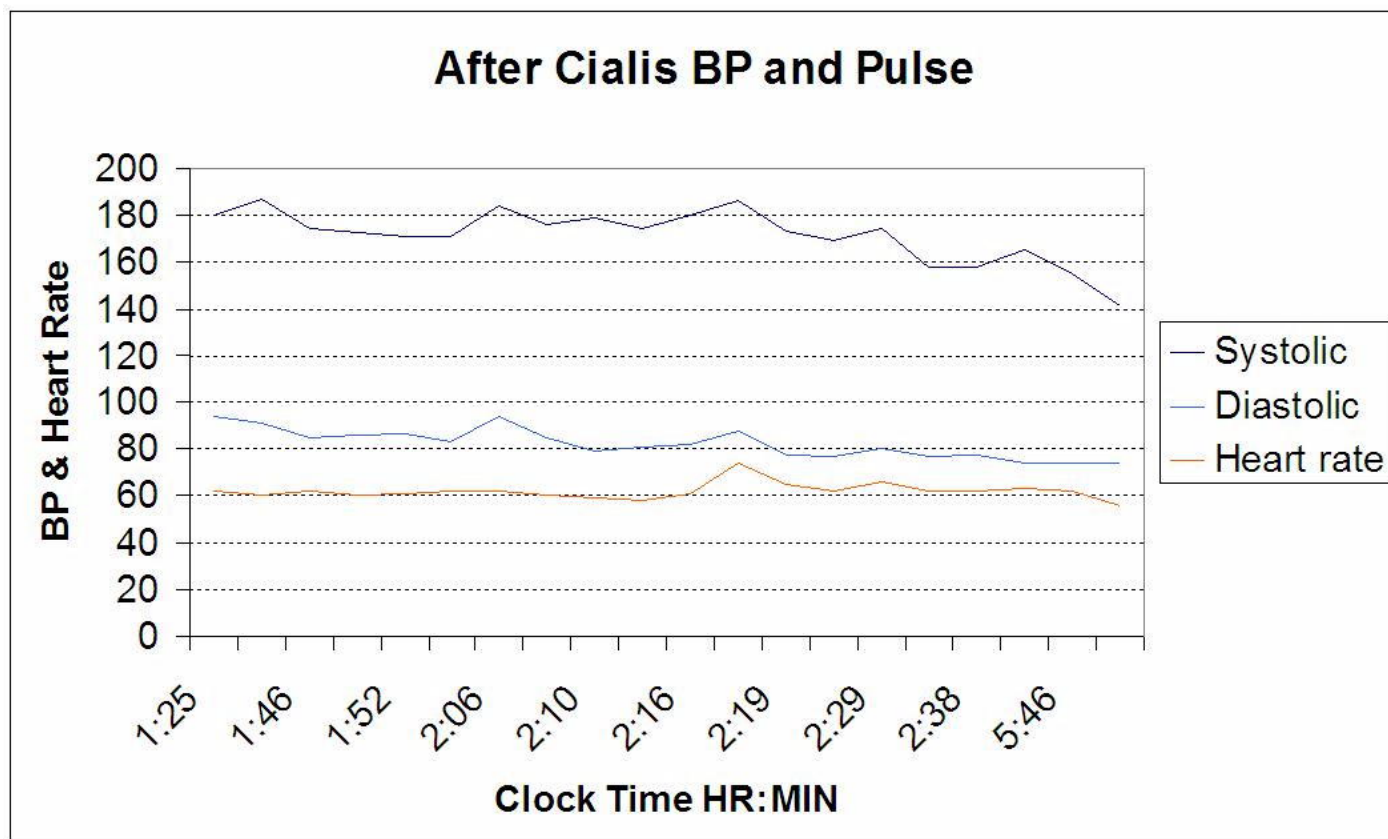
Here is a graph of Gunnar's data, followed by the numerical values. Note the systolic & diastolic downtrend:

Time is HR:MIN in clock time.

Time | Systolic | Diastolic | Heart rate

1:25	180	94	62
1:31	187	91	60
1:46	174	85	62
1:49	172	86	60
1:52	171	87	61
1:55	171	83	62
2:06	184	94	62
2:07	176	85	60
2:10	179	79	59
2:13	174	81	58
2:16	180	82	61
2:18	186	88	74
2:19	173	78	65
2:27	169	77	62
2:29	174	80	66
2:36	158	77	62
2:38	158	78	62
2:39	165	74	63
5:46	155	74	62
6:21	141	74	56

George



Thank you George!

Here are some remarks:

Note how even the heart rate is while the diastolic is going down. The load on the heart is changed by decreasing the contractions of the heart muscle. Those of you that has a low pulse rate during the night and get into trouble may have noticed that the same is true when the pressure is building up. The rate is the same but the contractions get harder and harder and sometimes at the end it will resolve in Afib initiated by heart-muscle stretching. I do not see any increased sympathetic activity because of Cialis.

Another way to look at it is, that the heart must be regulated by the oxygen level in the blood and not by the baroreceptors or beta -receptors on cardiac and smooth muscle tissues. Seen from this perspective beta-blocking is not of much use from preventing Afib, on the contrary, which I will come to later, instead the beta-blocking may be good at limiting the heart rate once the Afib is started and thus get the heart to work more efficient due to the lack of atrial kick during Afib. See:

<http://cvphysiology.com/Arrhythmias/A011.htm>

Cialis (sildenafil) is a PDE-5 inhibitor and PDE-5 has only been found in the penis and the lungs. The penis is not a muscle. It is more like a sausage shaped balloon that is getting filled with blood, which happens when stimuli sends signals to nerves in the arteries that feeds the penis to release NO which leads to relaxation due to Ca^{++} blocking in artery the smooth muscle. As the penis is not a muscle and thus is not performing any work we can forget it. (Women have the same kind of blood filled tissue but in an inverted shape). Remains the lungs if the effect of PDE-5 should be explained. The arteries in the lungs have an inner smooth muscle layer called endothelium which among many things regulates blood flow. See:

<http://cvphysiology.com/Blood%20Flow/BF011.htm>
http://circ.ahajournals.org/cgi/content/full/109/23_suppl_1/III-27#FIG1

" Another important mechanism regulating the release of NO is shearing forces acting on the luminal surface of vascular endothelium. By this mechanism, increased flow velocity stimulates calcium release and increased cNOS activity."

Note that the relaxation of the inner lining of the artery then is automatically regulate by a close loop mechanism that does not involve the autonomic nervous system. The heart is just checking the oxygen in the blood and is increasing the strength of the contractions accordingly relying on the endothelium to do its job to regulate the diastolic pressure by relaxing the artery smooth muscle by releasing NO and thus block Ca^{++} . When this is not working the pressure rise and the heart muscle gets overloaded and as a way out Afib starts.

The endothelium can be damaged by different things like inflammations, smoking or just aging which means that NO production may be decreased and the endothelium will then loose its ability the relax with increased flow velocity. This inability must be relatively more important at rest when the flow is low and especially at a slow heart rates when the flow velocity fluctuate within small velocities, which explains why a person with low pulse rate is more sensitive to damage of the endothelium than one with a higher pulse rate and why Afib will occur at sleep or at relaxation after exercise when flow velocities are low. I cannot find any other reason why I get this decrease of diastolic pressure if not from this mechanism. It also explain why a beta-blocker that makes the heart rate even lower, doesn't work so well with a vagal afibber.

Also there is not much difference with a vagal Afibber and a sympathetic afibber. Both get in trouble because of heart muscle stretching, but one because of strong contractions at low HR and the other at high HR and the vagal Afibber can get Afib after an Afib incident when the heart muscle is "over-worked" at a lower high HR.

When I played tennis I noticed that my warm-up period was usually much longer than my competitor, which mean that I usually lost the first set but then crushed my opponent in the 2nd set and then we both got tired in the 3rd. We are talking about old-boys tennis here. The dysfunctional endothelium explains why.

I have also tried to document my dysfunctional endothelium by taking bike rides over the same route and taking BP and HR at regular intervals and have found that with Cialis in my body I get a marked decrease in HR and BP after a certain time, about 30 min. Without Cialis I actually overdid it once and got into Afib. The HR and BP were just continually raising and the decrease in diastolic BP, relaxation due to increased blood flow did not happen. Without Cialis I really need to start slowly to get the NO production going, which happens but takes even longer without Cialis, then I can increase the workload without getting Afib.

This theoretical model also explains why supplemental L-Arginine works if not the whole way for me yet.

One can also be hesitating to the benefit of making an ablation under these circumstances. The underlying problem still exists and will probably get worse with increasing age.

I have been diagnosed with LAF which I see as a name for those cases of AF that current medical knowledge of my cardiologist put those Afib cases he cannot explain. A problem for a vagal afibber is that the situation goes out of hand at night when the office is closed. So you can have an excellent BP in the physician's office but will go into Afib at night due to high BP and low HR. I was promised by he chief physician to have an ambulatory BP monitor for 24 hours. Unfortunately when they called and put it on me I had the day before taken a Cialis pill and the result from the test was that I had an excellent BP for my age. When I told the physician the reason why, he refused to schedule me for another test and insisted that there was nothing wrong with my BP and he had just proved that.

Gunnar

Hi Gunnar,

Thanks for your comments!

On another note, a word of caution:

To all who are thinking about purchasing a monitoring device - remember that the Polar S810i, FreezeFramer, or the Vernier ECG device were not developed to monitor afib. So do not expect any consultation or support in this area from the manufacturer. As to the Vernier ECG, it is my understanding that most medical ECG devices require you to be a doctor or to have a prescription to have one. The Vernier has specific disclaimers that their devices are not to be used for diagnosis of a medical condition - they are marketing it for high school science class. Therefore you are on your own when you are using it to monitor your afib. You need to be able to figure out how to read an ECG waveform (there are a lot of web resources for this) yourself. If you are a technophobe that requires a lot of handholding and support, the Vernier is probably not for you.

If a lot of people started calling them and asking about afib, it might ruin it for the rest. So if you get one of these devices, just be prepared to be self-sufficient, or perhaps ask a question on this forum.

That being said, I think these devices are great and have provided me with a lot of information that has helped me control my afib.

George

Here is a graphic of the Vernier ECG (my home ECG sensor mentioned above) output using the supplied Logger Lite software.

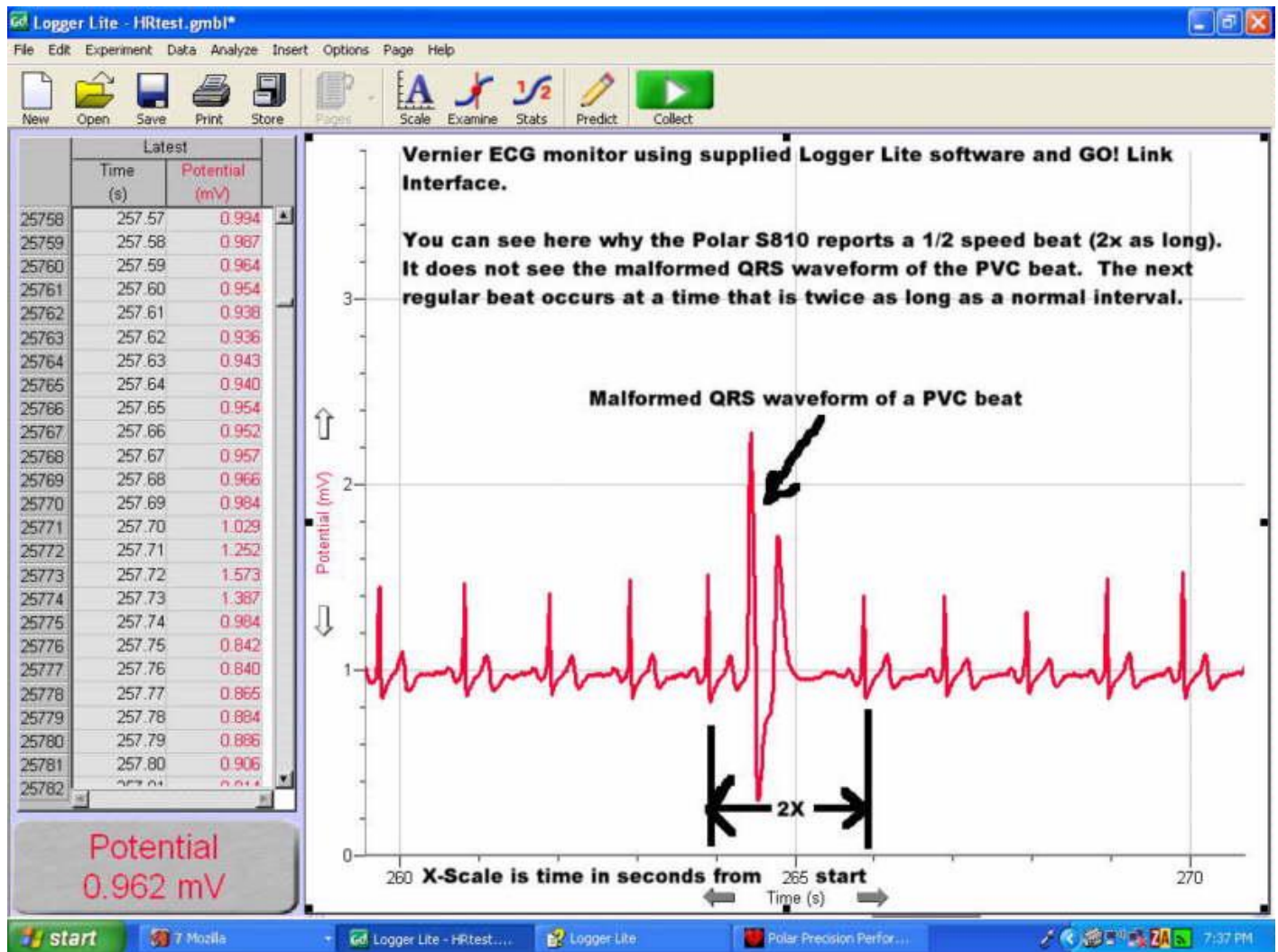
This file was 1900 seconds long (31.66 minutes). It was set to sample 100 times a minute, so it is 190,000 records long. If you use this software and pull up an old file, you should have the ECG device plugged in, otherwise the software doesn't know what to do with the file. This file itself is less than 700kb in size, but with 190,000 records, it takes 30 or more minutes to load (this would argue for shorter sampling times!).

I then set the X-axis scale from 0 to 11 (or 11 seconds wide). You can zoom in and zoom out and move through the file this way. It takes a while to analyze this much data (though many devices <\$1,000 only record 30 seconds or less of data).

As I previously mentioned, while capturing data, you should set the x-axis scaling to "strip chart" with a fairly narrow window & it will give a fair approximation to the normal ECG monitor display. What is shown here is a lead II configuration of the 3 leads (referenced above).

When sampling, you can tell the software how long you want to sample and how many samples per second. If you want to see your ECG waveforms, this is a very useful device. It does not come with interpretation software, such as a Holter would, to detect irregular beats. You must do this visually by examining the waveforms (though this is not as arduous as it might be since the irregular beats tend to stand out).

George



George

Thanks for the graph and excellent comments.

For international customers, Vernier charges more than the US prices. I contacted the regional Vernier reseller and the price was approx 50% higher than the US list. So maybe it is beneficial to search for other purchasing means. I will probably use US-based friends (fellow work colleagues) to purchase for me and then ship to me.

Regards

Rob

"It was set to sample 100 times a minute." Make that 100 times a second. Also detect should be detect. Anyone reading my posts will realize that proofreading is not my best skill! As long as I'm posting corrections, in this line from my first post here "but I noticed that my pulse sounded very 'wired'", wired should be wierd.

George

Hi George,

I hope you noted that the article you pointed to is questioning if the PDE-5 (sildenafil) really is changing the sympathetic tone.

The author is also questioning that the study by using healthy young men would have any bearing on persons with cardiovascular problems.

Gunnar

This is interesting.

Sildenafil Inhibits β -Adrenergic-Stimulated Cardiac Contractility in Humans

<http://circ.ahajournals.org/cgi/content/abstract/112/17/2642>

Gunnar

Gunnar,

You caught me in "high speed" mode again. I was looking for a reference to make my point and did not read carefully. My apologies. Good call!

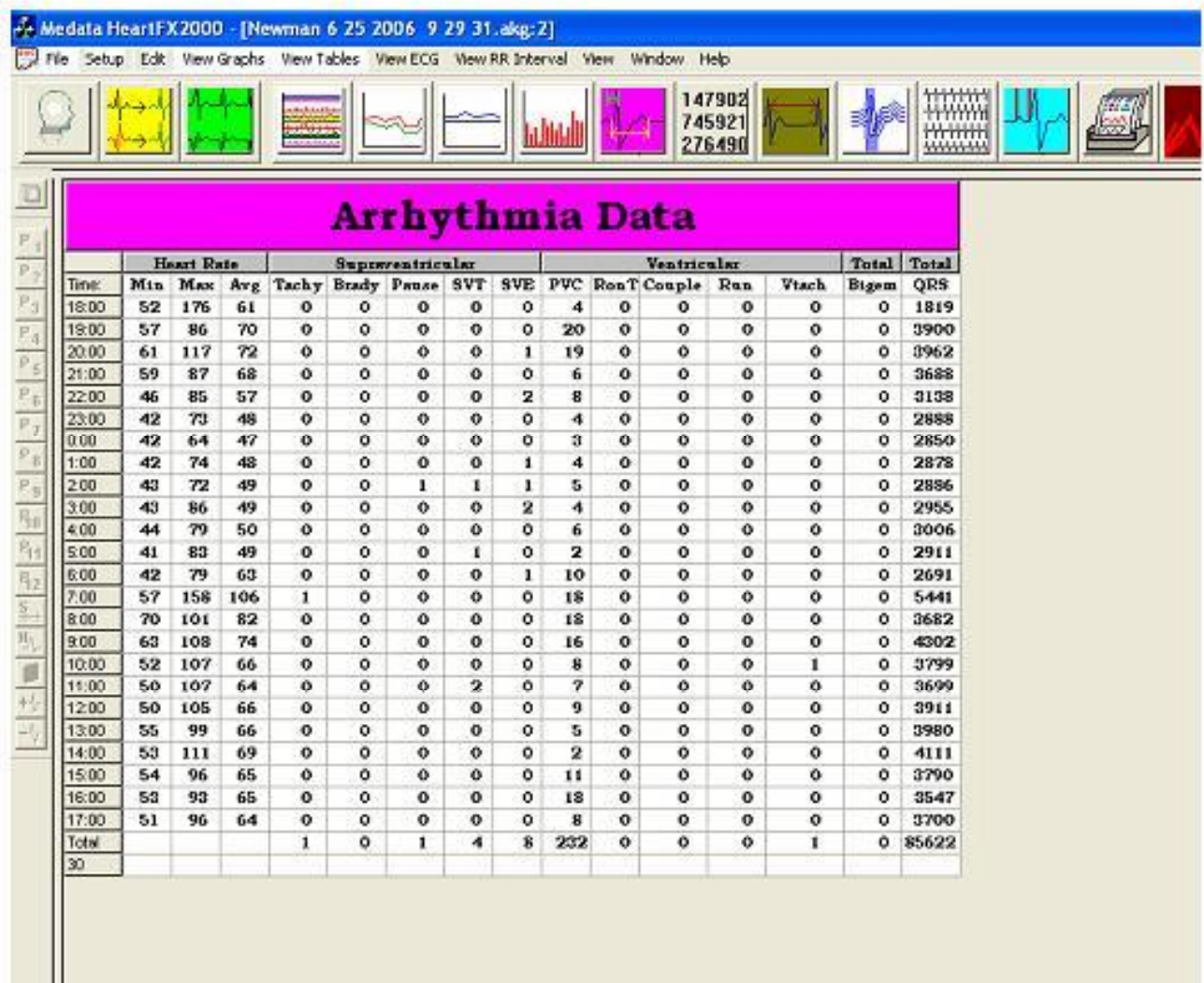
George

Holter Monitors

I'm sure that many of you have had Holter monitor testing. This is commonly done for 24 hours. It records your ECG reading for later analysis. The number of electrodes used can vary depending upon the monitor. This can be very useful in actually diagnosing afib. Although many may have had the experience of being fine while the monitor was on, and then later having afib.

I recently had a 24-hour Holter analysis done for "fun." While the device was lent to me by a physician friend who did the analysis, this was done on a personal basis and not with me as a patient. This was a seven-electrode monitor.

Here is the output I was provided (though much more could be provided if need be, including the ECG waveform at any time during the recording). It shows that I had 232 PVC's over 24 hours (less than 10 per hour). I also had 8 SVE's and 4 SVT's. SVE's are commonly known as PAC's. I assume the SVT's are multiple SVE's in a row. In any case this is less than 1 every 2 hours. This is very good.



<http://home.att.net/~g.e.newman/uHolter1.jpg>

Here is my log. I'm not sure if the time scale on the Holter is shifted by a half an hour, but you can correlate a bit

18:30 start monitor
 18:32 meditate
 19:02 stop mediation
 19:30 take evening supps.
 20:00 eat dinner
 22:20 bed
 5:30 wake up, lie in bed
 6:05 turn on left side for ~ 7 minutes
 6:20 yoga
 6:35 meditate
 7:01 treadmill
 7:35 end exercise

7:50 breakfast & supplements
8:13 shower & detach monitor
8:25 reattach monitor
9:00 office
17:00 home
17:15 meditate
17:40 stop meditation
18:30 turn off monitor

Here is a graph of PVC's for 24 hours:



<http://home.att.net/~g.e.newman/uPVC1.jpg>

You can see they generally decrease after taking supplements. If I really wanted to try to completely minimize them, I could follow a routine as suggested by Wil, here in this post:

=====

http://www.afibbers.net/forum/read.php?f=4&i=11410&t=11390#reply_11410

Author: Wil Schuermann (---.dial.gorge.net)
Date: 06-20-06 10:08

Using the jargon common here, a SVE is a supraventricular ectopic [(also called an atrial ectopic) or (also called a PAC (premature atrial contraction))].

They are most commonly called PACs here (premature atrial contractions). They are spontaneous: i.e. not caused by the signal generated by the sinus node.

Some people have none, some people have 2 to 4 per hour, and some people have 1 to 2 per minute. When they are happening at an average rate of 1 to 2 per minute (thousands per day) you would begin to worry a little, but some live with such rates long term.

Two PACs in a row is called a doublet. Three PACs in a row is called a triplet. While I've never seen the terms used: four PACs in a row would probably be a quadlet; five PACs in a row would probably be a pentlet; and six PACs in a row would probably be a sexlet. So, when your ECG shows six atrial ectopics in a row you are displaying the characteristics of a sexlet.

A perfect heart would have no PACs. The rest of us, not being quite perfect, all have some. It is common to assume that fewer is better. Most of us find that a steady intake of supplemental potassium (about 100 mg of K (potassium) per hour) will substantially reduce the PAC rate. If our PAC rate is around 1 to 4 per hour we are usually content.

In my case I combine: about 1 teaspoon of potassium chloride; either fresh squeezed orange juice or grapefruit juice; and seltzer water (carbonated water), to make about 1.5 liters of liquid, which I sip throughout the day. For convenience I also add 1/4 to 1 teaspoon of magnesium citrate powder to the liquid, which gives me my basic supplemental potassium and magnesium each day.

I'm guessing that a long string of PACs would be designated as SVT (supraventricular tachycardia or atrial tachycardia). Atrial flutter could probably be regarded as an endless string of continuous premature atrial contractions.

If you are not already, get serious about your potassium and magnesium supplementation.

=====

My guess is that if I followed Wil's protocol of drinking electrolyte water, it would reduce my PVC rate. However, what is really important is my PAC (or SVE/SVT) rate. Since adding the two together gives 12 in 24 hours (1/2 per hour), I'm really not concerned at all, and except as an exercise in curiosity is not worth doing, for me. It might be very worthwhile for someone else.

This was an interesting exercise, what was most interesting for me was to see the variation of PVC over time and in relation to my supplements. My PVC and PAC rates as described by the Holter are not very different than those I've determined by sampling 20 minutes morning and evening during meditation.

My understanding is that to own a Holter monitor in the US, you must be licensed by the FDA (physician) or have a prescription (script) for one. I am sure that Wil would say that having one has been very useful to him, even though he is in NSR from his Natale ablation. It enabled him to work out the formula for the electrolyte solution he ingests and have objective data about its effectiveness.

Holters are expensive (\$3,000 - \$5,000 US) including the analytical software, which is required. They are a useful tool.

George

My RLx is now at 50. It has been jumping around from 32 to 50. Correlation with afib? I think so. It looks like 50 is the max that will display on the watch. I'm looking forward to seeing the number after my electro cardioversion this afternoon.

I sure wish that I had that Vernier ECG hookup now to get so extended before and after strips. I'm gonna order that soon.

ArtSD

Art,

"It looks like 50 is the max that will display on the watch."

I don't see any reason why this would be true.

George

Well, shortly after I had 111! I thought it got stuck. And right now, a sweet 6!!!

ArtSD

Hi

I sent a support request to Polar to find out if the RLX data series could be graphed on the Curve report. Their response was:

The RLX value is shown only at the cursor value. However if you open the listing view (View - Listing) and select to see the R-R data as RLX values, you will be able to copy the data to e.g. excel and create a graph in there.

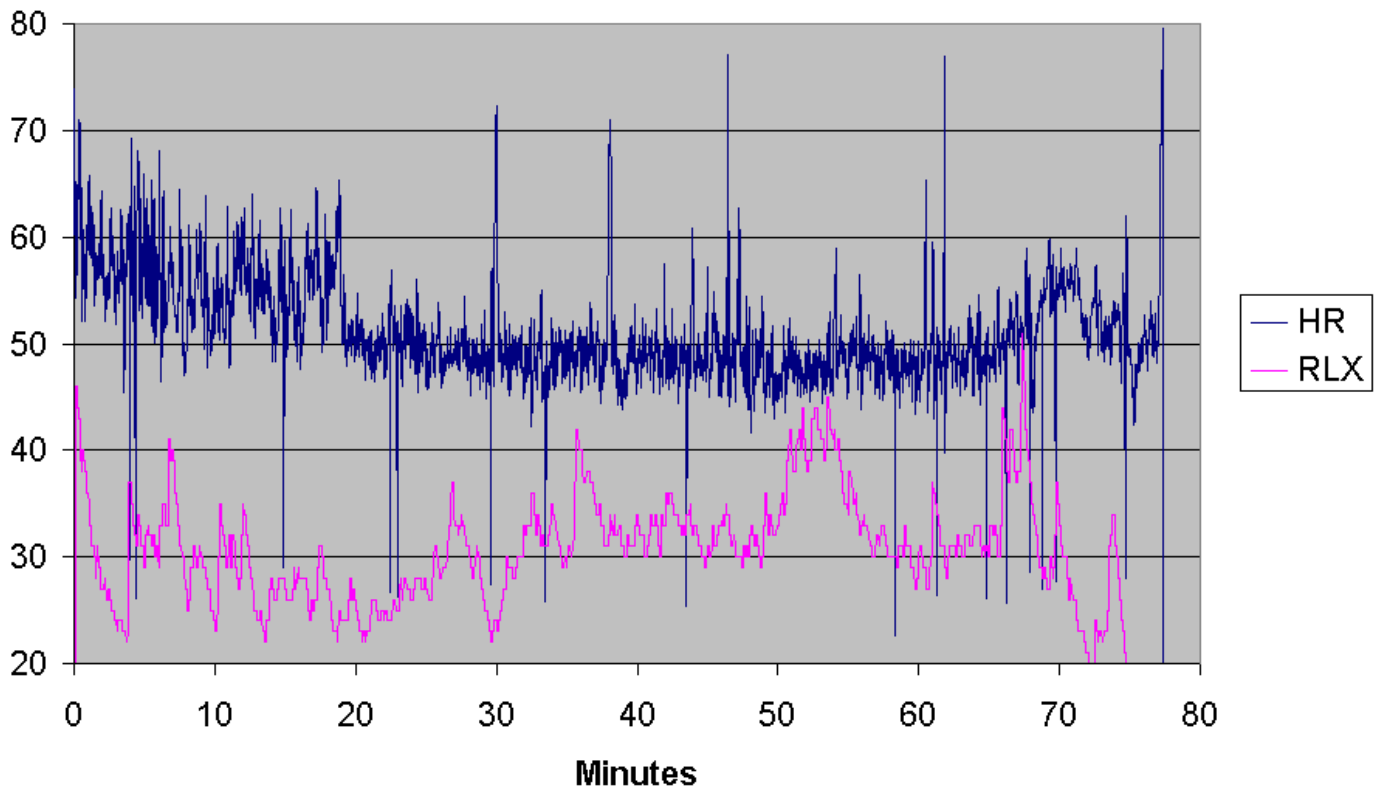
Rob

Rob,

Thanks!

Here is a graph of some output using this info. I didn't, but a person would probably want to filter the file first to get rid of ectopics as these will increase RLX a lot.

Heart Rate & RLX



I wrote a little program to take a Polar txt export file of the beat length in ms, and a saved Excel CSV file of the RLX, and reformat to a file you can import as a comma delimited file to Excel. Like this:

```
Minutes Heart_rate RLX
0.01 73.89162 0
0.02 62.37006 0
0.04 60.18054 0
0.06 62.24067 0
0.08 54.24955 0
0.09 61.41249 0
0.11 63.29114 0
0.12 64.30869 0
0.14 64.30869 0
0.15 65.21739 46
0.17 64.86487 46
0.19 61.16208 46
0.2 56.49717 46
0.22 58.36576 46
```

It is an old DOS QBasic 4.5 program (I rarely code anything anymore), so it wants DOS 8.3 file names. The code is here (the listserv gets rid of any spacing as formatting):

```
INPUT "Rlx Filename (Excel CSV) Dos 8.3 ", rlx$
INPUT "HR file (Polar export) Dos 8.3 ", hr$
INPUT "HR_Rlx output filename Dos 8.3 ", HRRLx$
OPEN rlx$ FOR INPUT AS #1
OPEN hr$ FOR INPUT AS #2
OPEN HRRLx$ FOR OUTPUT AS #3
LINE INPUT #1, a$
time = 0
counter = 0
WHILE NOT EOF(2)
IF counter = 0 THEN INPUT #1, timex
INPUT #2, hr
time = time + hr
counter = counter + 1
IF counter < 13 THEN INPUT #1, rlx
IF hr > 0 THEN hr = 1000 / hr * 60 ELSE hr = 0
PRINT #3, INT(time / 600) / 100; ","; hr; ","; rlx
IF counter = 13 THEN counter = 0
WEND
CLOSE #1
CLOSE #2
CLOSE #3
END
```

A compiled version is here

<http://home.att.net/~g.e.newman/RLX.EXE>

This can be run from the command line - probably be better if the EXE was in the same directory with the other files, though will work with short subdirectory names (as in DOS).

George

Here are a couple of threads where there is discussion of using a Holter monitor to determine ectopic rates with respect to potassium and magnesium intake.

<http://www.afibbers.com/forum/read.php?f=6&i=21988&t=21988>

<http://www.afibbers.com/forum/read.php?f=6&i=22685&t=22668>

Also, if someone with a little programming skill wanted to play with my program above, a copy of the DOS basic compiler QBasic is available here:

<http://qbnz.com/pages/faq/index.html>

George

Regarding plotting RLX values on the Polar ... I certainly made more work for myself than necessary. Once the RLX is shown in the listing view, the Active View Properties can be changed to One Column and then the resulting output can be copied to Excel to be graphed. The same is true of the heart rate. In this fashion, a graph of HR & RLX vs Time can be put together very quickly.

I hadn't coded anything in a long time, so it was interesting to go through that process for a few minutes.

George

Here are some past threads discussing various monitoring devices. The last two threads also have links to plots for the Polar S810 and FreezeFramer.

ECG machine discussion

<http://www.afibbers.net/forum/read.php?f=3&i=3355&t=3336>

Vernier ECG discussion (along with some others)

<http://www.afibbers.com/forum/read.php?f=6&i=23672&t=23666>

James Driscoll has links to plots of his Polar S810 in this thread:

<http://www.afibbers.net/forum/read.php?f=3&i=7732&t=7687>

Hans has plots from his FreezeFramer in this thread:

<http://www.afibbers.net/forum/read.php?f=3&i=8409&t=8409>

George

Here is info on an earlobe pulse monitor that Susan passed on to me. It has Bluetooth capability, if you get the correct interface. The website does not list a price. I did see that it has Mac software, which is unusual for these devices. It should give essentially the same type of reading as a FreezeFramer.

http://store.pasco.com/pascostore/showdetl.cfm?&DID=9&Product_ID=1507&Detail=1

<ftp://ftp.pasco.com/manuals/English/PS/PS-2105/012-07277E/012-07277E.pdf>

article:

<http://images.apple.com/education/solutions/accp/science/pdf/HeartRate.pdf>

For those that have a Polar S810, this German site shows you can just wet your fingers and hold the chest strap pads to get a reading. I tried it and it works. Also PC says he has used his chest strap on the outside of a wet t-shirt.

<http://www.hrv24.de/HRV-Tipps.htm>

George

Susan sent me some pricing information on the Pasco HR monitor above. It looks like you could put together an earlobe HR monitor system for \$170 US or so.

I spent some time on the Pasco website - <http://store.pasco.com>

It looks like Pasco is in the same market as Vernier (see the ECG monitor above). They have an ear lobe heart rate monitor, that Susan mentioned, a chest strap HR monitor and an ECG monitor. It is like the Vernier setup in that you need an interface device along with the "probe" (like the HR monitor).

They do have interface devices that transmit wirelessly via Bluetooth. They also support Palm devices. They also have MAC versions of their software.

Using their setup, Palm & perhaps Bluetooth, it would seem like you could construct your own Holter monitor. Now it may not collect for 24 hours, but it might be sufficient for what you want - & would be better than the 10 to 30 second collection lengths of some of the "layperson" ECG devices.

This is all speculation on my part - not having done so. Again, if you are a technophobe, this is probably not the path for you, at least until someone who is tech savvy does it and posts a "how-to".

There is a full fledged digital Holter listed now on E-Bay for \$1,795, including software. However the software does not scan for ectopics, you have to do this manually. An "upgraded" version with automatic scanning costs about \$2,995 US. This may be overkill for home monitoring.

George

After reading more on the Pasco site, I learned that the sensor for the chest strap HR monitor (which is a Polar unit), does a 5 beat moving average. This would not be good as it would smooth out the PAC's & PVC's that you want to see.

I can't tell if the ear lobe unit also does this averaging. It would certainly be a question to ask before purchasing one.

George

Here is an email that Susan recently sent me.

Hi George,

I wasn't sure if I told you about this monitor since you are currently posting about monitoring. I might have had but can't remember...

http://www.healthfrontier.com/Products/product_detail.cfm?productid=1

ecg@home monitor - two thumbs and an optional third lead. You record only 10 seconds at a time which you can record an actual ECG. I was told you can keep pushing the button and it will record and record so you will get clips of 10 seconds with probably a half a second delay between readings. My Cardiocheck is identical but it can't be connected to a PC. I have in the past pushed the record continuously and it does work...sort of.

Susan

=====

Their website does say: U.S. Federal law restricts the sale of this device by or on order of a physician.

Their website lists the price as \$328 US, but if you click on buy now, it is \$1,395.00 US.

I'm also not clear if this device will print on your computer or if you have to transmit the data to a center & from there to your doctor. A bit confusing & certainly some talking to the company would be in order for anyone interested in this device.

George

I'd like to say a bit about artifacts in the data. If I really want an accurate reading with any of my devices, I take the reading while I meditate. I am careful to not move any body parts and sit quietly.

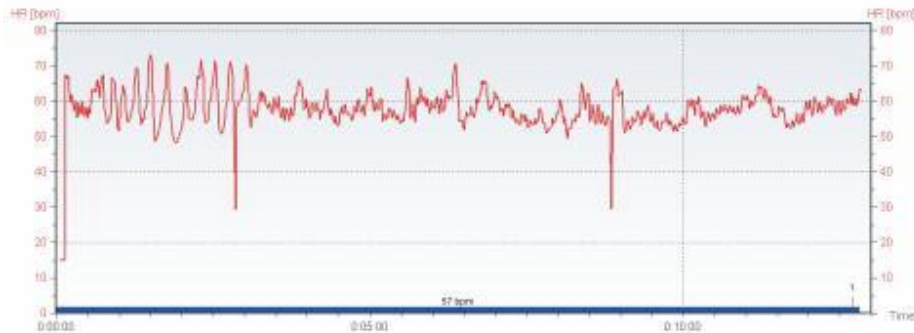
Below is a link to screen shots of three examples. The top shows a reading taken with a Polar S810i while I walked on the treadmill for 35 minutes. There are a few ectopics and the down spikes - PVC's are probably real as they show a heart rate almost exactly 1/2 that of the beats before. This is not artifact. The PAC's may be artifact, as a my 24 hour Holter test a few days before, which included 30 minutes on the treadmill, showed only 8 PAC's in 24 hours (and they had to manually remove a lot of artifacts during the exercise section).

The middle shot is one where I was meditating. This shows 2 PVC's. The bottom graph looks really ugly & was taken immediately after meditating. You would think I was in afib, or ready to go there by looking at it! However I can assure you that it is probably all artifact. What is different between walking on the treadmill & outside? When I walk on the

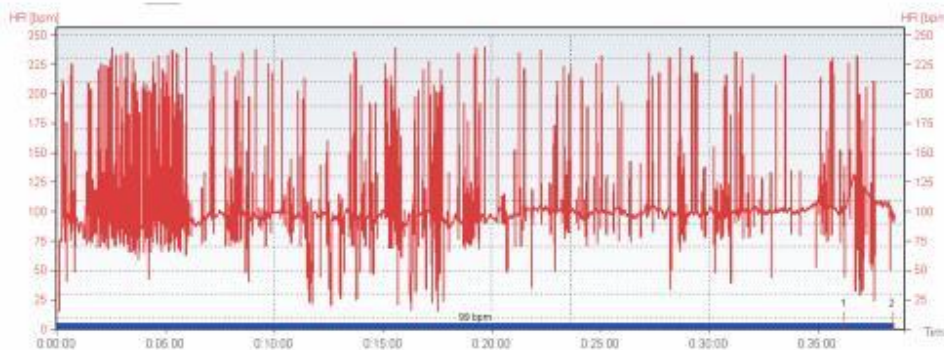
treadmill, I mostly increase the elevation, up to 30%, rather than increasing the speed. Outside, I move my arms a lot, where I don't on the treadmill. This shows a dramatic difference.



Walking on treadmill
7/5/06



Meditation
7/10/06 before
walking
(shown
below)



Walking
outside at 5
MPH 7/10/06

George

I just purchased "ActiveEcg" from <http://www.activecenter.com>

Very helpful and useful ECG gadget. Pretty expensive but they are offering the bluetooth adapter right now for the same price...if one is interested.

Opinion: Not bad. I am able to "see" on my Treo 650 any PACs, etc and if I am in AF or NSR plus has flashing pulse. One can only record strips for 30 seconds at a time but will monitor on your Palm's screen until your battery of your Palm gives out. Excellent transfer to PC and excellent software included to print up ECG strips. Has optional software to fax ECG from phone if one is away from their computer. Quite easy learning curve. Has interpretation software of a dozen or more heart rhythm ECGs so one can compare and make a self diagnosis. Excellent customer service. Any questions. Jeff- owner/paramedic, is accessible with answers to questions.

Downside: does show artifact if one is in motion. Best results if one is still. Will not self diagnose ST-T segment interpretation. It is only intended for basic ECG rhythm identification...which is what I wanted this device for.

This company has a free demo software to all versions of Palm PDA and has their manual online for viewing before purchase.

Susan

My review of my recent purchase of the ActiveECG from www.activecenter.com....so in case anyone is interested, read on:

The device is easy and has a quick learning curve, excellent software with online software downloads and bluetooth connection from Palm to PC for printing. I use a Treo 650--better screen visibility than the Palm 500m with this software. Palm faxing options are available if one is away from a computer and wants to send the recording to a doctor. Great company customer service...they are quick to answer questions either via phone or emails. ActiveEcg offers a free online demo software download of various rhythms such as NSR, AF, Async pacemaker, Asystole, Asystole, Atrial flutter, Atrial Tach, Bigeminy, PVCs, Sinus Arrhythmia, SVT, V-fib course, V-fib fine, and Ventricular tach. With comparing ones ECG with the demos, the monitor provides easier self-diagnosis.

One can also record and save ActiveEcg readings. Each maximum saved strip length is 30 seconds but one can view the ECG continuous as long as your Palm battery lasts.

Another Palm free software is PalmEKG which offers more demos of various heart rhythms which is a good companion in self diagnosis.

The only con I can think of is that one needs to stay still when recording a reading otherwise there is slight artifact. They do have a disclaimer that "The frequency response of ActiveEcg, the Palm OS handheld display, and a windows printer is of monitoring quality and does not provide the resolution required for diagnostic and ST-T segment interpretation. It is intended only for basic ECG rhythm identification"...which serves my needs in reassurance that I am in NSR. I may add that one can zoom in and out on each heartbeat displayed on the monitor and I found the resolution good.

Susan

I've used my Active ECG monitor for 2 years+ and it has been one of the best purchases I've ever made. I'm still using a Palm m100. The screen is small, but large enough to view the rhythm. After doing a hot synch to the computer, the strips are super clear. Every now and then, I would advise using a little alcohol to clean the leads where they insert into the monitor.

Keep me posted on how you get along with your new toy!

Marian

I have been using the AfibAlert ECG device for the past few months. I find his device the best source for me of checking to see if I am in AF or NSR. I also own the ActiveECG device from www.activecenter.com and in addition Medisana's Cardiocheck unit. Of the three I prefer AfibAlert because of the clarity of the readings, easy printing of strips and the ease in using the device--no bulky items needed to use. Afib Alert also has new cloth wrist band electrodes which provides a reading almost flawless for a compact ECG...no artifact or tremors.

It is really a good device. I was blown away the first time I took a reading. Since being in NY for 8 weeks I've been to Mt. Sinai ER once and the hospital's cardiac dept once...both times his device has helped...and their tech support is perfect. I am visiting NY for three months and brought AfibAlert as my monitor of choice. It fits in my purse, quick to use, no liquids, and if I don't want to use the wrist electrodes all I need to do is use the two thumb [no liquid!]

Susan

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