Holter workshop

David Newman MD

CARDIAC & ARRHYTHMIA
SERVICES TORONTO

International Winter arrhythmia School
Collingwood ON
February 10,2017

disclosures

Honoraria from Boehrehinger, Bayer, astra zenica

BOD cardiocom

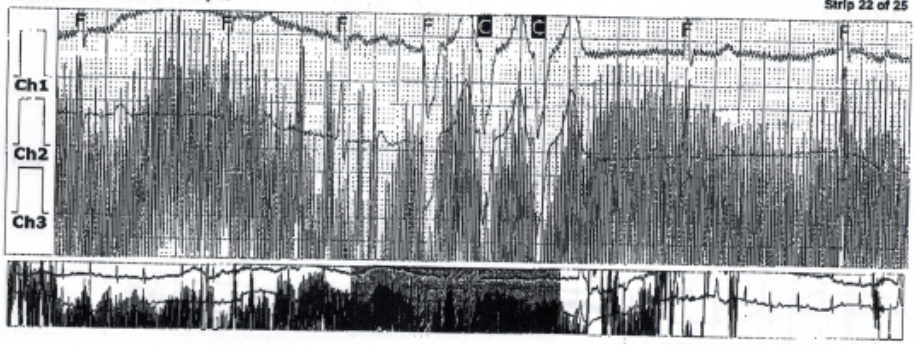
Will talk about off label use of all devices

(where labels exist)

SELECTED STRIPS

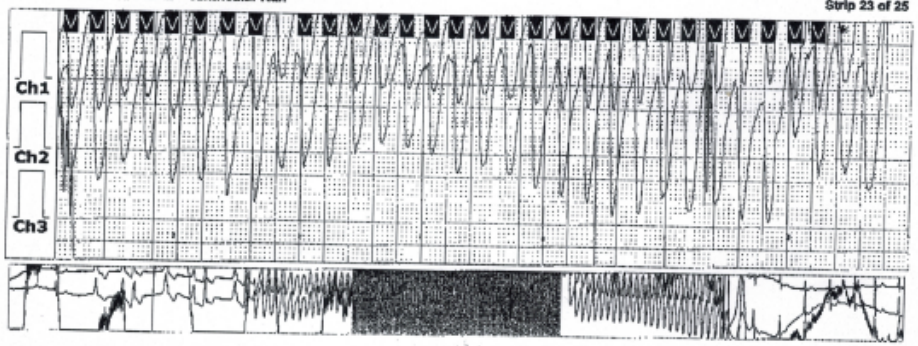
8:07:14 AM D2 67 BPM Couplet

Strip 22 of 25



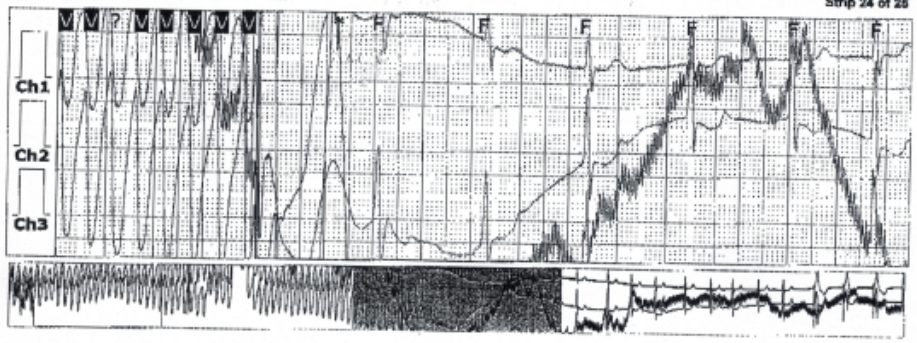
9:11:51 AM D2 273 BPM Ventricular Run

Strip 23 of 25



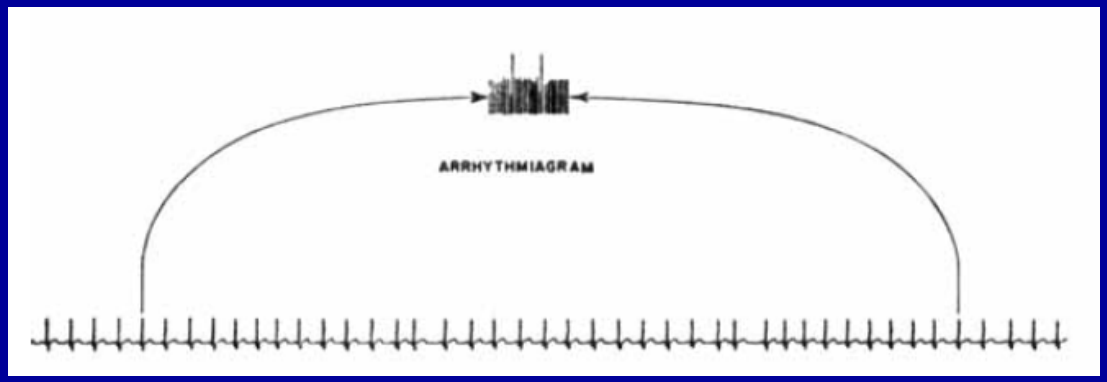
9:12:02 AM D2 286 BPM Ventricular Run

Strip 24 of 25



New Method for Heart Studies

Continuous electrocardiography of active subjects over long periods is now practical.



Norman Holter. Science 1962;143:1212

HR monitor

Device but no or limited software, storage, and analysis

Cardiocom , ECG pen

Holter data stream

Raw signal is ECG vs. time signal

APB count, VPB count

Clinical
Symptom rhythm correlation
Event prediction
Rhythm progression
Therapy decisions

Analytic:
HRV
Turbulence
RR distribution
QT/RR
ST

Holter data stream

Standard counts:

VPB counts:

- denigrated , independent value of NS-VT debate
- critical pre-post VPB ablation
- role in congenital CHB (with mean rate and rate liability)

Automatic for afib detection : the problem of signal:noise ratio

Light and colour: the morning after the deluge – moses

GW Turner 1843

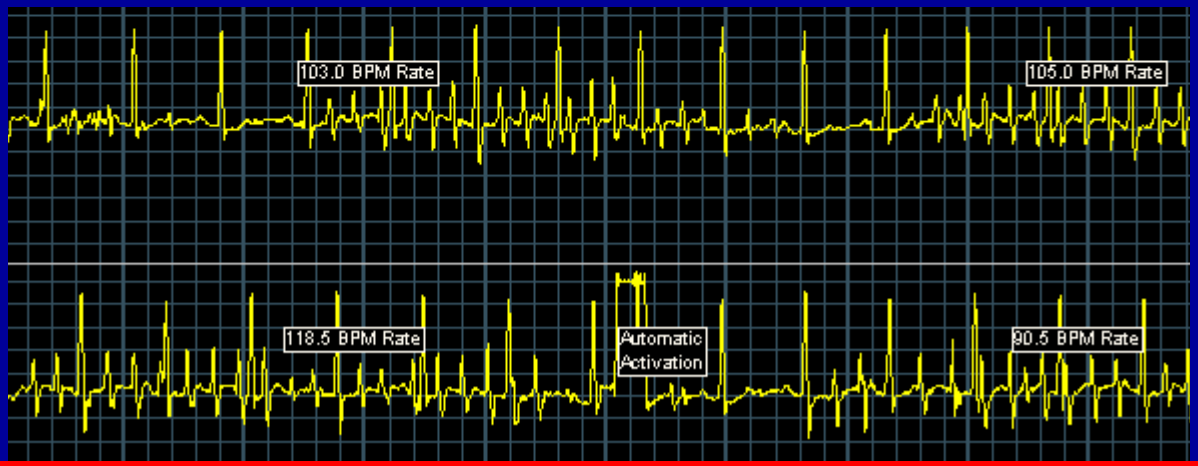
Automatic for afib detection : the problem of signal:noise ratio

Light and colour: the morning after the deluge – Moses

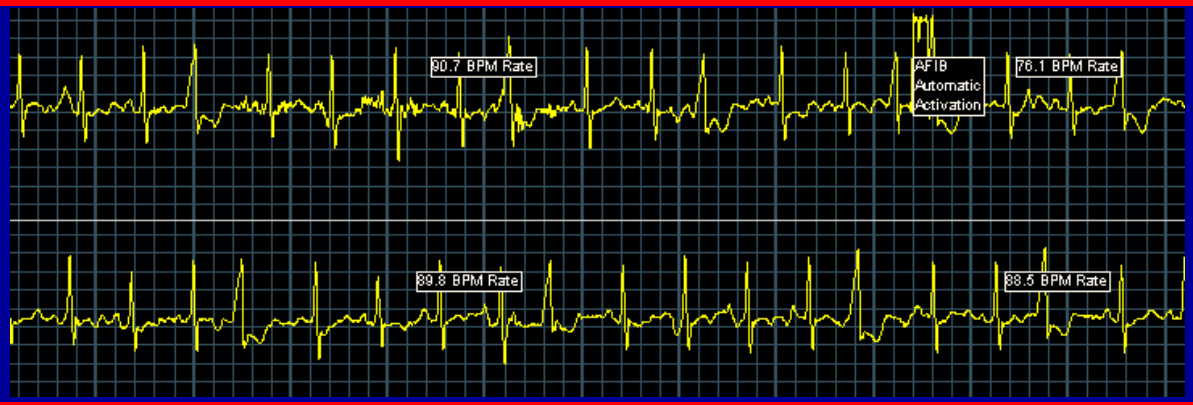
GW Turner 1843

signal: noise with ELR auto detecting

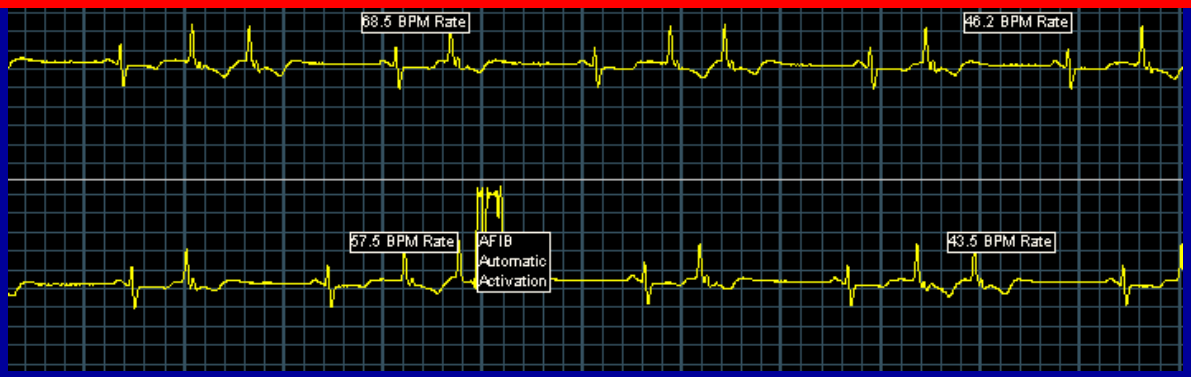
Case 1

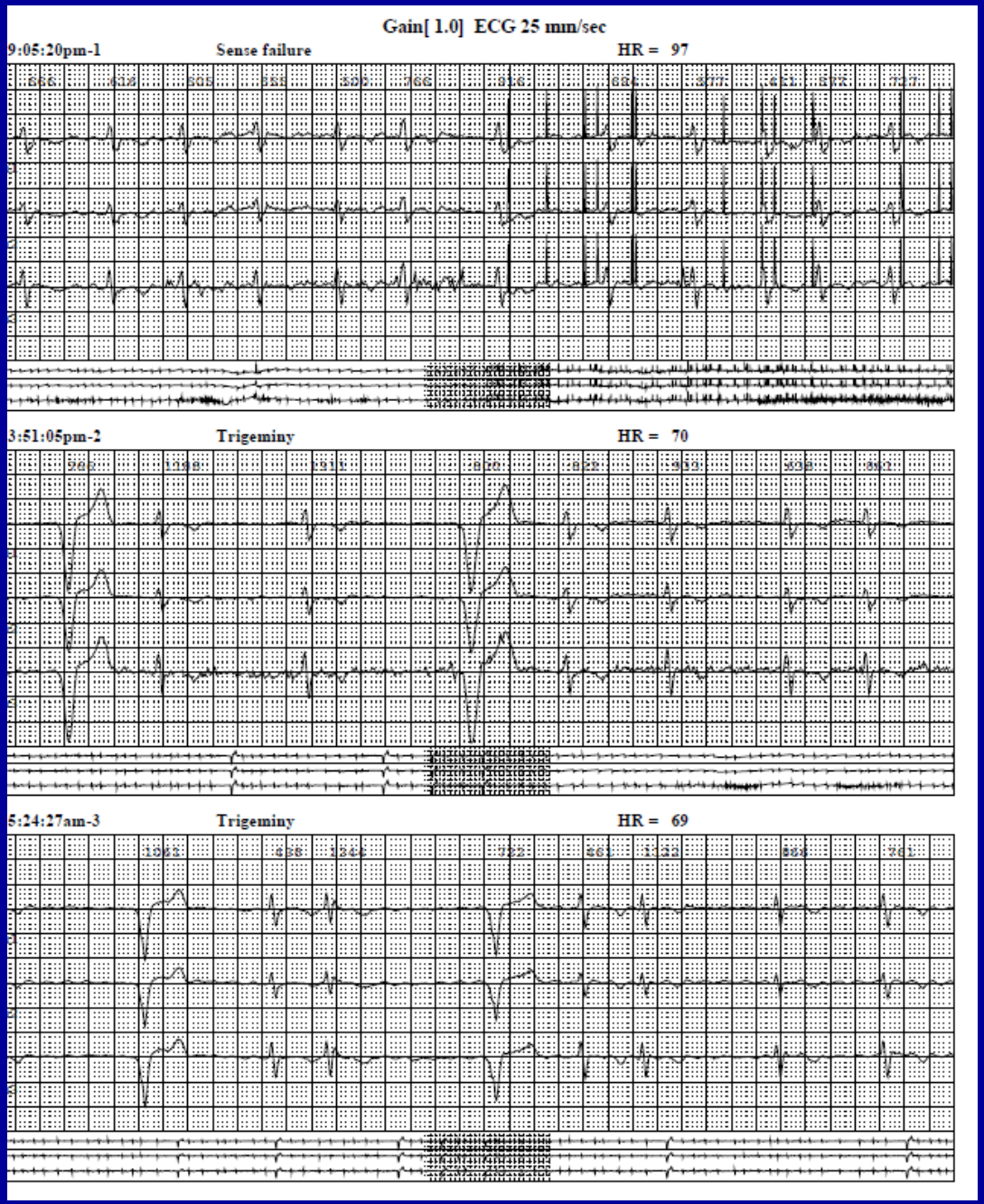


Case 2



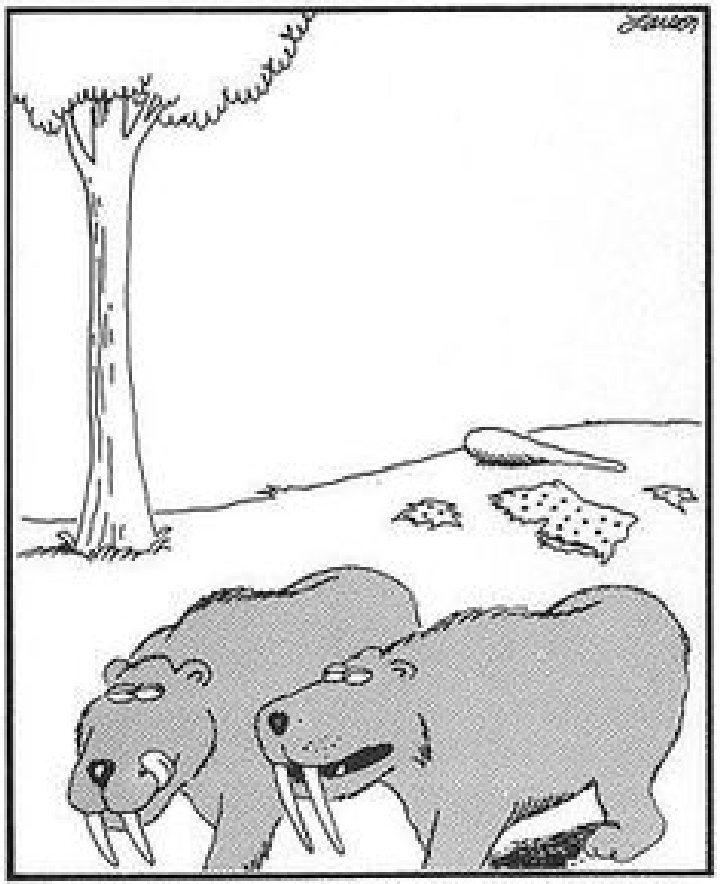
Case 3



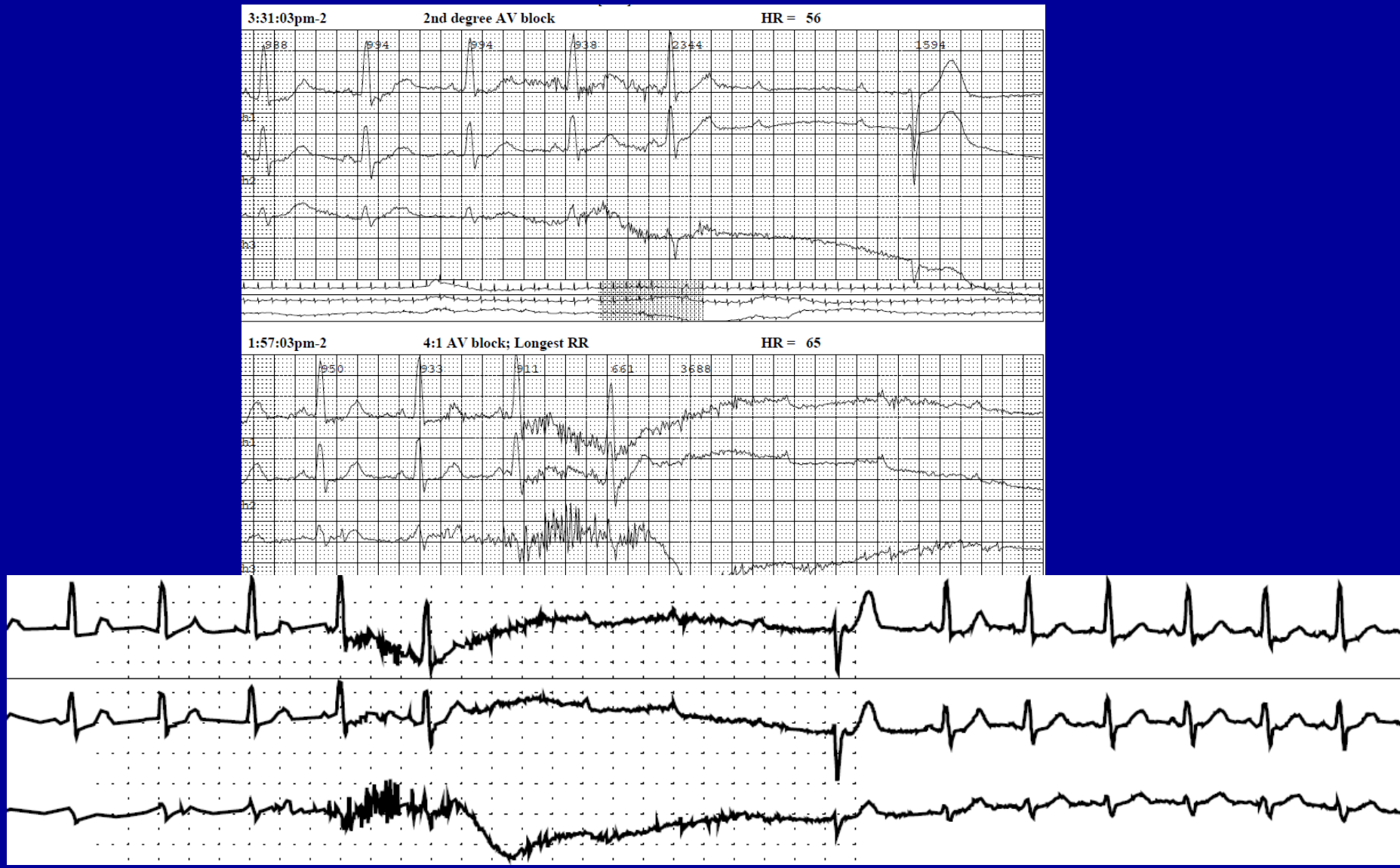


VVI-R

Asymptomatic

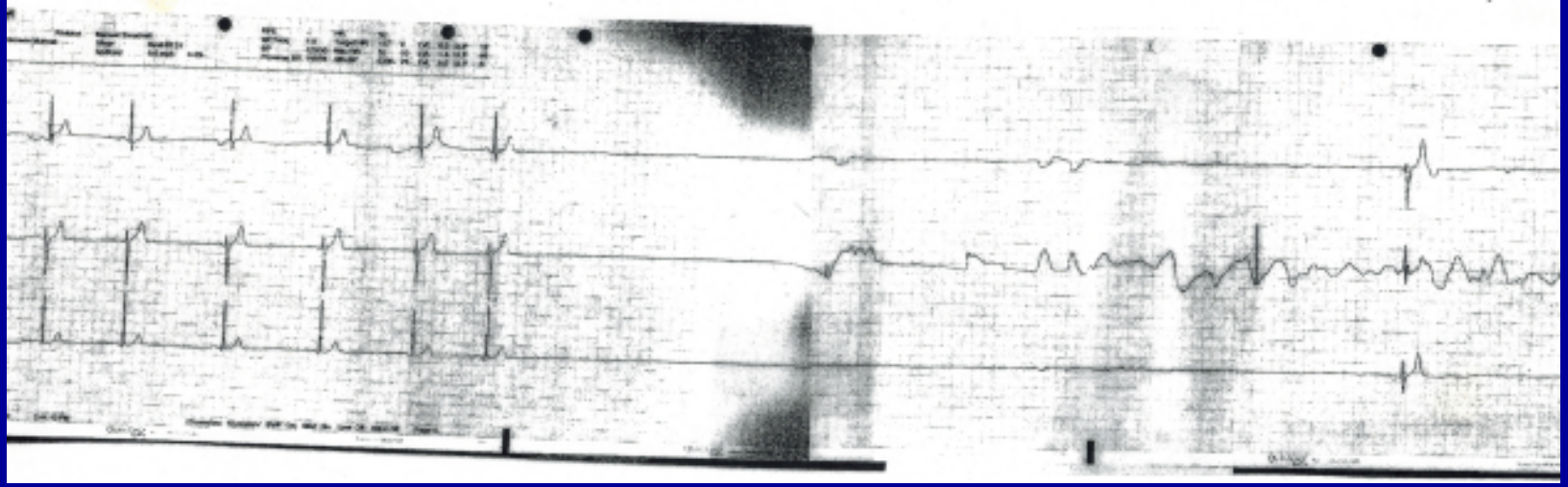


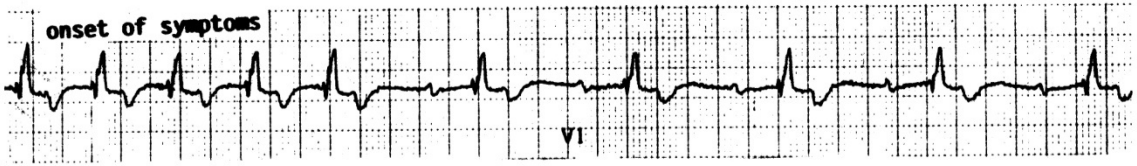
"I've heard all kinds of sounds from these things, but 'yabba dabba doo' was a new one to me."

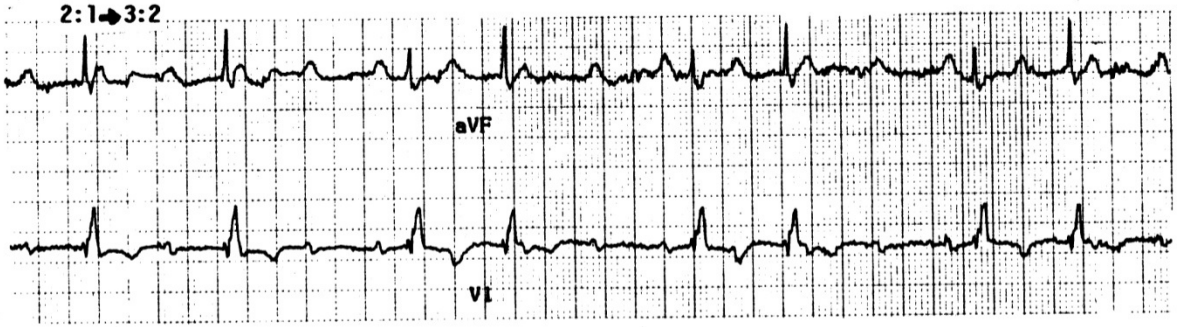

3:31:03pm-2
2nd degree AV block
HR = 56
988
994
994
938
2344
1594
1:57:03pm-2
4:1 AV block; Longest RR
HR = 65
950
933
911
661
3688

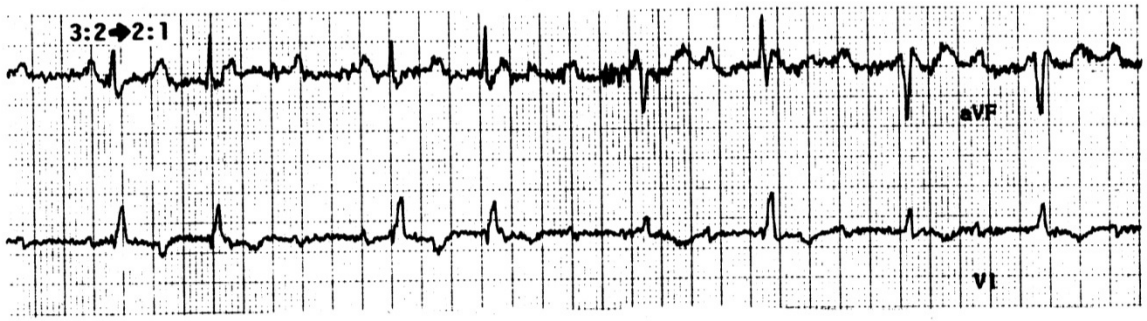
4.8s

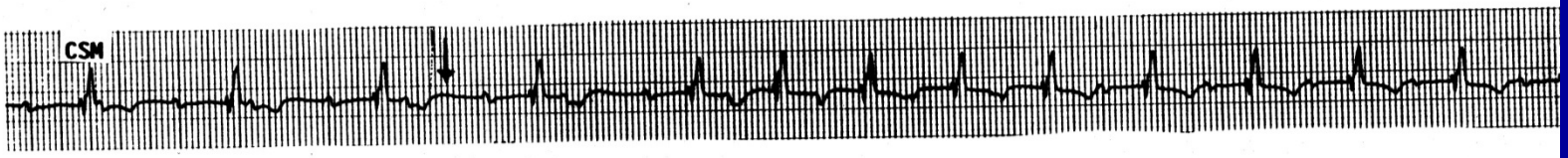

Fallingb
Rd

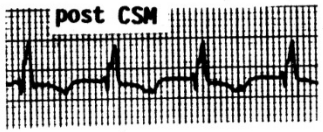


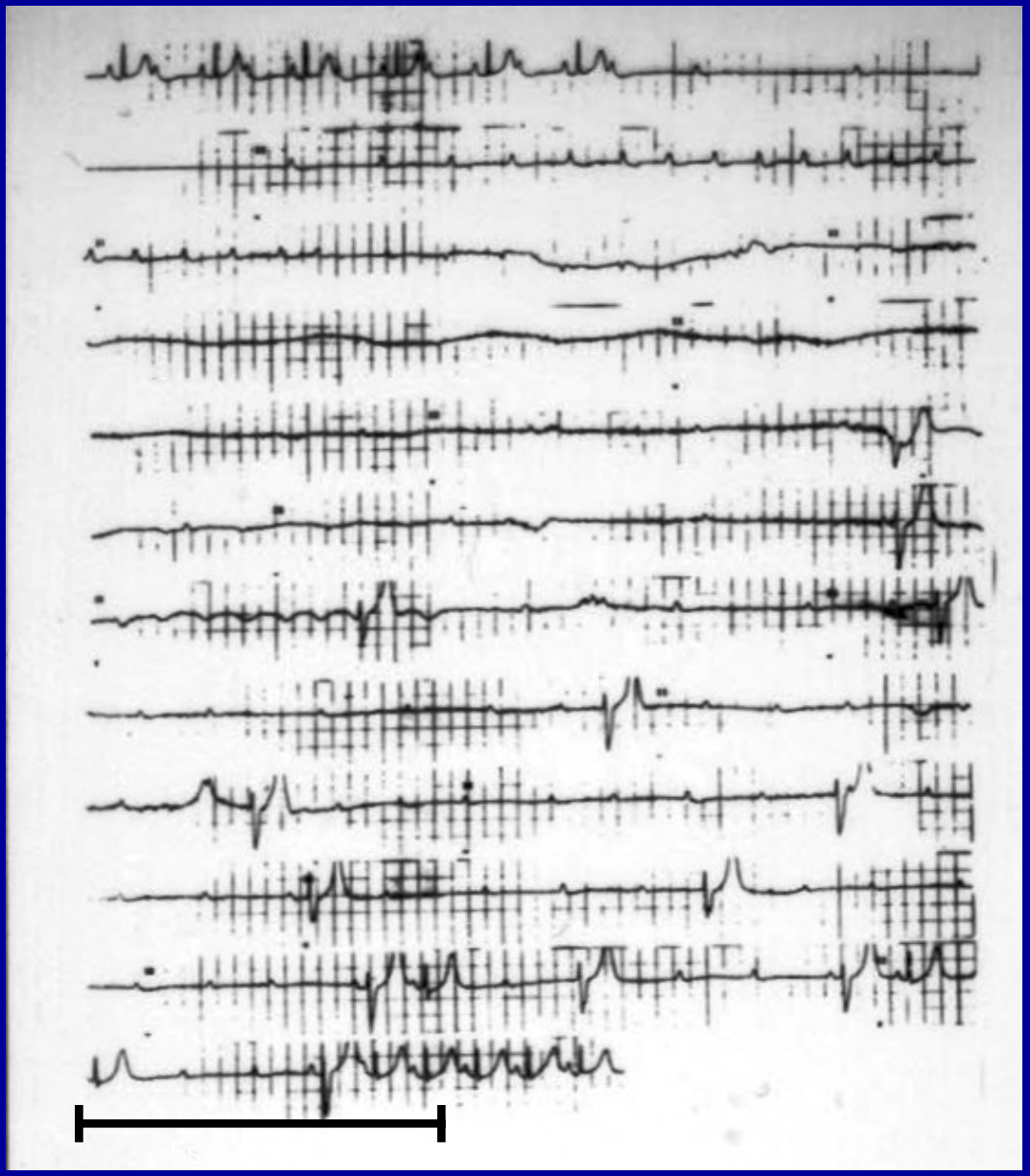

onset of symptoms
VI


2:1➔3:2
aVF
VI


3:2➔2:1
aVF
VI


CSM


post CSM



The danger of making normal pathologic:

40 yr commercial pilot

Vasovagal episodes as a passenger age 31 (etoh etc)

Normal holter with nocturnal slowing

Normal SAN and AVN on stress

Normal echo/stress echo

Letter or reassurance and full clearance FAA and MOT

Date of Birth:	3/25/1976		**Scan Number:**	7074	
I.D. :	5503		**Date Recorded:**	1/2/2017	@ 16:55
Age:	40 Years		**Date Processed:**	1/6/2017	
Sex:	M		**Recorder Num:**	007074	
Analyst:	IK		**HookupTech:**	MT	
Physician:	David Newman				
Indications:	Rhythm Assessment		**Medications:**		

The patient was monitored for a total of 47:59 hours. The total time analyzed was 47:00 hours. Start time was 4:55pm1. There was a total of 194715 beats. Less than 1% were Ventricular beats, less than 1% were Supraventricular beats, and patient is not paced.

Mean Heart Rate:	69	Total Beats:	194715
Maximum Heart Rate:	140 @ 8:25pm2	Tachycardia beats:	8073 (>=100 BPM) 4%
Minimum Heart Rate:	39 @ 6:30am2	Bradycardia beats:	18719 (<= 50 BPM) 10%
Pauses:	0 (> 2.5 sec.)	Longest RR at:	1.978 seconds at 5:33am3

Ventricular Ectopy

Total:	14
Single:	14
Pairs:	0
Total Runs:	0
Beats in Runs:	0
Longest Run:	0 @ 4:55pm1 (0 BPM)
Fastest Run:	0 @ 4:55pm1 (0 BPM)
RonT:	0

Supraventricular Ectopy

Total:	28
Single:	20
Pairs:	4
Total Runs:	0
Beats in Runs:	0
Longest Run:	0 @ 4:55pm1 (0 BPM)
Fastest Run:	0 @ 4:55pm1 (0 BPM)
Aberrant:	0

RR Variability

SDNN:	216 ms
pNN50:	29.75 %
RMSSD:	86 ms

ST Absolute

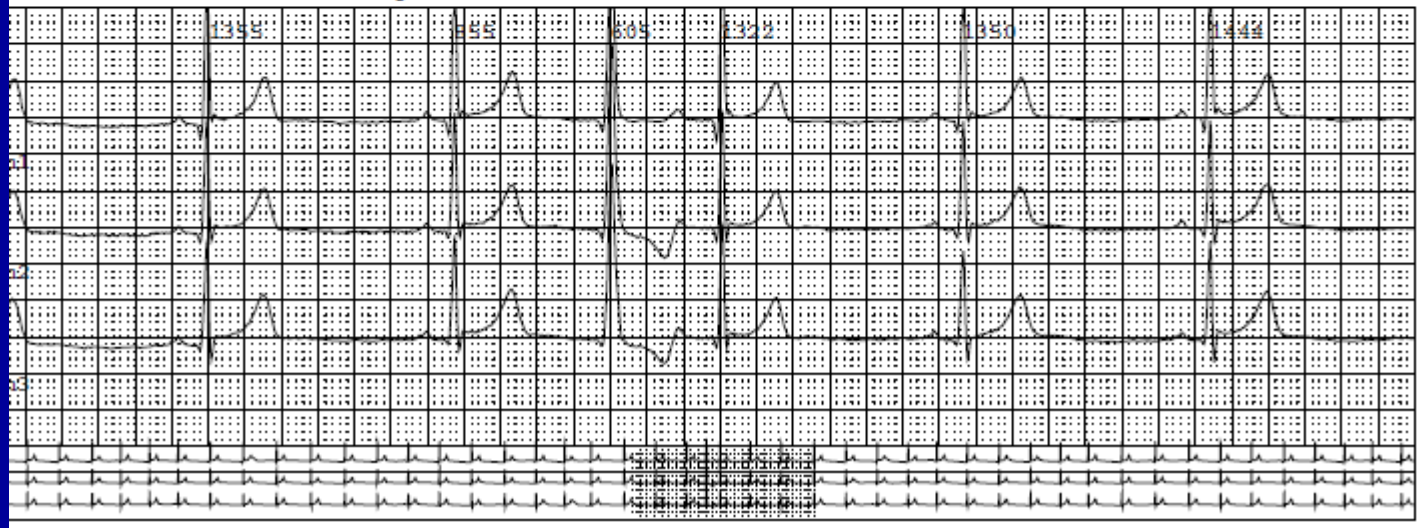
Depression:	*** mm
Elevation:	*** mm

FULL-SIZED STRIPS

Gain[1.0] ECG 25 mm/sec

2:56:03am-2 SVPB pair HR = 71

7:09:06am-3 SVPB pair HR = 46



体检鉴定总结论记录

体检诊断：

鉴定结论：不合格

限制：

1、戴矫正镜☐ 2、戴远视力矫正镜☐ 3、携带近视力矫正镜☐

4、限制飞行时间 小时☐ 5、其他☐

建议：

体检合格证 已发 ☐ 未发 ☐

体检机构名称：民用航空人员体检鉴定所

主检医师：2016年12月10日

No:

民用航空人员体检鉴定结论通知书

：

经体检鉴定，Francois 的身体健康状况不能满足《民用航空人员体检合格证管理规则》（CCAR-67FS-R2）附件A第一章第 条规定。

体检诊断： 。体检鉴定结论：不合格

特此通知

体检机构：民用航空人员体检鉴定所

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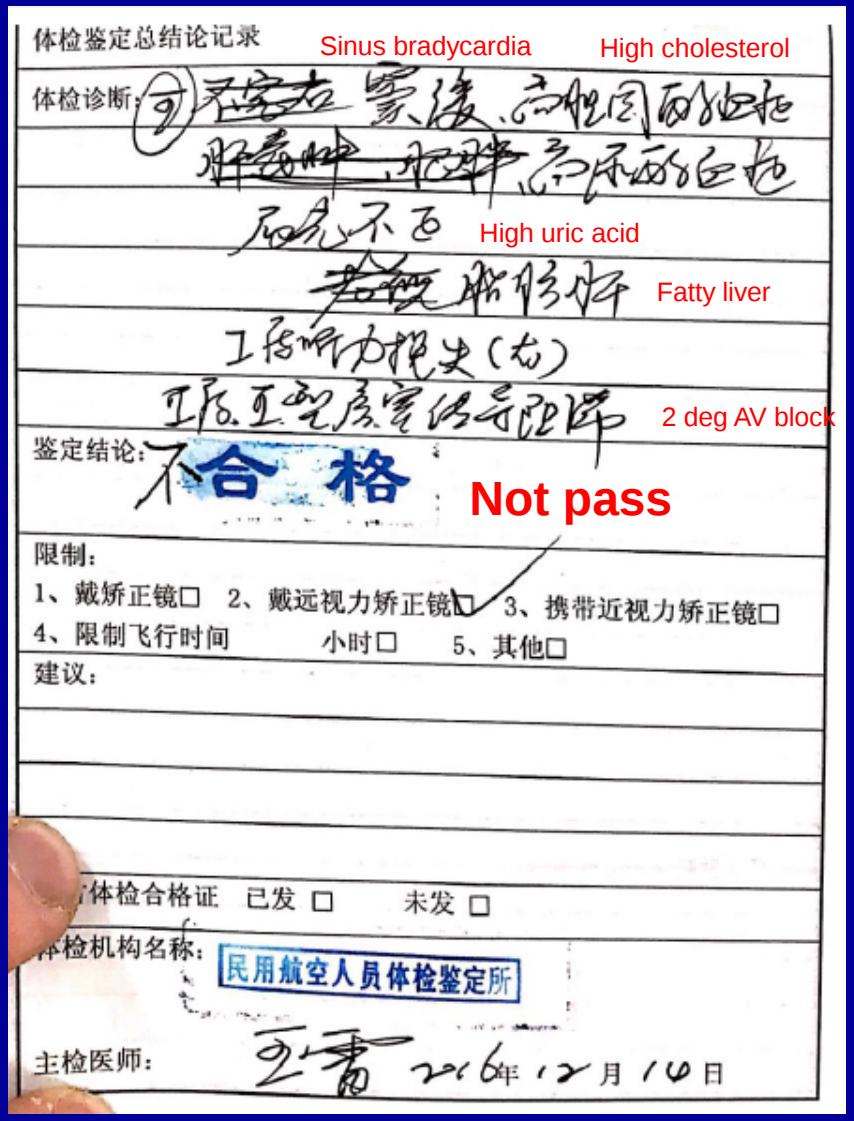

体检鉴定总结论记录

Sinus bradycardia　　High cholesterol

体检诊断：

High uric acid

Fatty liver

2 deg AV block

鉴定结论：不合格

Not pass

限制：

1、戴矫正镜☐　2、戴远视力矫正镜☐　3、携带近视力矫正镜☐

4、限制飞行时间　　小时☐　5、其他☐

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体检诊断：　。体检鉴定结论：不合格

特此通知。

体检机构（盖章）：民用航空人员体检鉴定所

2016年12月10日

No:

民用航空人员体检鉴定结论通知书

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经体检鉴定，Francois 的身体健康状况不能满足《民用航空人员体检合格证管理规则》（CCAR-67FS-R2）附件A第一章第 4(2) 条规定。

体检诊断：　。体检鉴定结论：不合格

特此通知。

体检机构（盖章）：民用航空人员体检鉴定所

2016年12月10日

中国民用航空局民用航空医学中心鉴定所

12导同步动态心电图报告

编号:2016111401	门诊号:	科别:	床号:	住院号:		起搏方式:	无
姓名: FRANCOIS	性别: 男	年龄: 40 岁	开始时间:2016/11/14 09:54:56				

开始/结束 时间: 09:54:56 / 09:55:01
记录总时间: 24小时 0分钟 5秒
总心搏数: 102270 次

最快心率: 120 bpm, (10:19:32)
最慢心率: 44 bpm, (03:06:06)
平均心率: 72 bpm

RR间期 >2.0 秒: 0 次
最长: 0.0 秒,发生时间:

室性心律失常

室性心搏总数: 0 次
室早形态数: 0
单个室早: 0 次
成对室早: 0 次
室性二联律: 0 阵
室速: 0 阵 ,共 0次
最快: 0 bpm, 发生时间:
最长: 0.0 秒, 最快频率: 0 bpm, 发生时间:
平均每小时室早: 0
一小时最多室早: 0, 发生时间: 09:54 -- 10:54

室上性心律失常

室上性心搏总数: 0 次
单个室上早: 0 次
成对室上早: 0 对
室上性二联律: 0 阵
室上速: 0 阵 ,共: 0 次
最快: 0 bpm, 发生时间:
最长: 0.0 秒, 发生时间:
平均每小时室上早: 0
一小时最多室上早: 0, 发生时间: 09:54 -- 10:54
房颤: 0阵
最长: 0.0 秒, 起始于: 09:54:56, 终止于: 09:54:56
房扑: 0阵
最长: 0.0 秒, 起始于: 09:54:56, 终止于: 09:54:56

心率变异

PNN50	: 12.8	RMSSD	: 80.7	SDSD	: 93.0
SDNN	: 162.0	SDANN	: 151.3	HRV三角指数	: 43.4

12导同步动态心电图报告

1. 窦性心律不齐
2. 疑Ⅱ型窦房传导阻滞
3. ST-T 轻度异常

报告医师: [illegible] 报告时间: 2016 年 11 月 17 日

中国民用航空局民用航空医学中心鉴定所

12 导 同 步 动 态 心 电 图 报 告

编号:2016111401 门诊号: 科别: 床号: 住院号: 起搏方式: 无

姓名: FRANCOIS 性别: 男 年龄: 40 岁 开始时间:2016/11/14 09:54:56

开始/结束 时间: 09:54:56 / 09:55:01
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平均心率: 72 bpm

RR间期 >2.0 秒: 0 次
最长: 0.0 秒,发生时间:

室性心律失常

室性心搏总数: 0 次
室早形态数: 0
单个室早: 0 次
成对室早: 0 次
室性二联律: 0 阵
室速: 0 阵 ,共 0次
最快: 0 bpm, 发生时间:
最长: 0.0 秒, 最快频率: 0 bpm, 发生时间:
平均每小时室早: 0
一小时最多室早: 0, 发生时间: 09:54 -- 10:54

室上性心律失常

室上性心搏总数: 0 次
单个室上早: 0 次
成对室上早: 0 对
室上性二联律: 0 阵
室上速: 0 阵 ,共: 0 次
最快: 0 bpm, 发生时间:
最长: 0.0 秒, 发生时间:
平均每小时室上早: 0
一小时最多室上早: 0, 发生时间: 09:54 -- 10:54
房颤: 0阵
最长: 0.0 秒, 起始于: 09:54:56, 终止于: 09:54:56
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最长: 0.0 秒, 起始于: 09:54:56, 终止于: 09:54:56

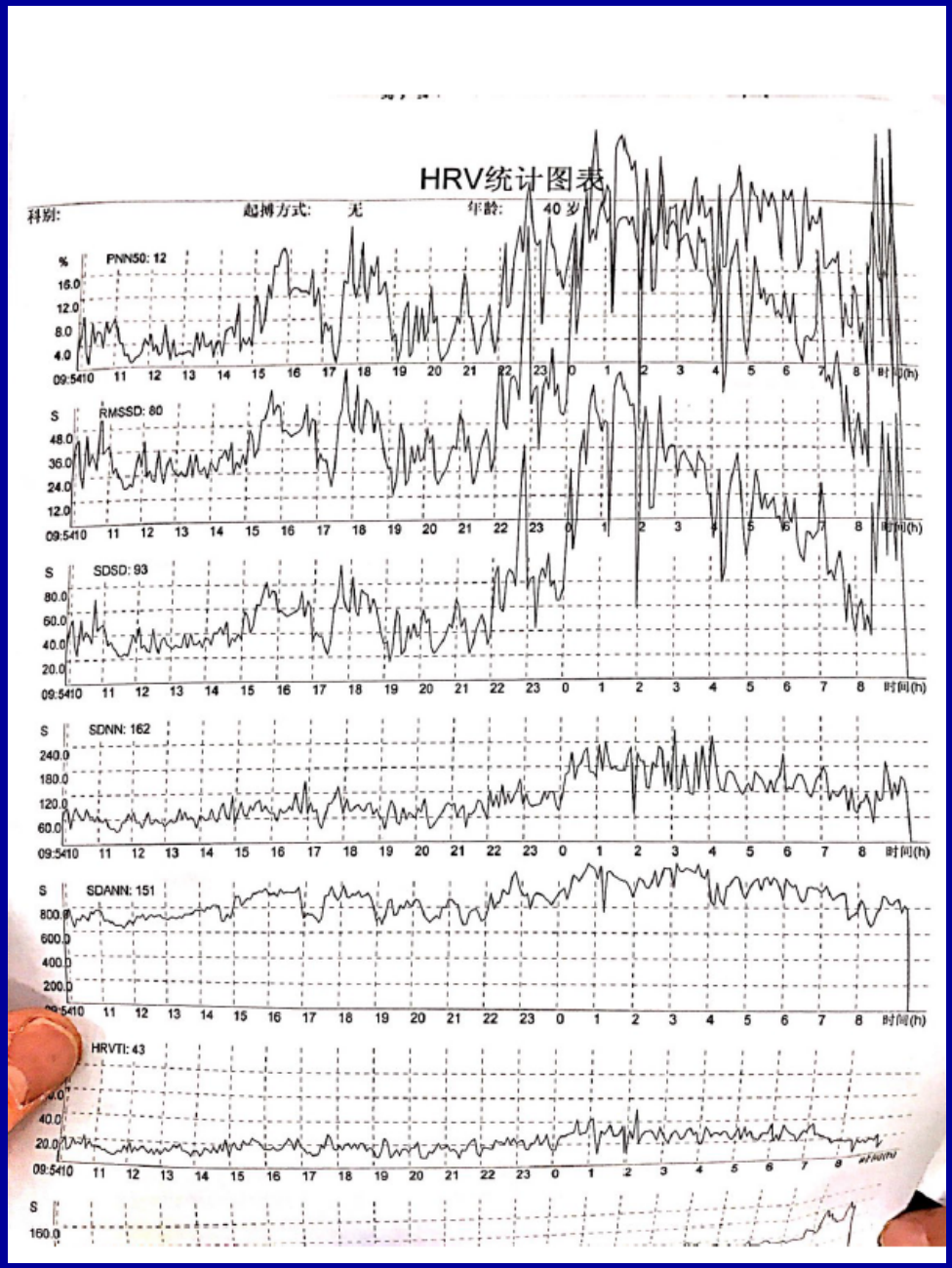
心率变异

PNN50	: 12.8	RMSSD	: 80.7	SDSD	: 93.0
SDNN	: 162.0	SDANN	: 151.3	HRV三角指数	: 43.4

12导同步动态心电图报告

1. 窦性心律不齐 Sinus arrhythmia
2. 二度I型窦房传导阻滞 2nd deg AV block
3. ST-T 相应正常 ST seg normal

报告医师: [signature] 报告时间: 2016 年 11 月 17 日


HRV统计图表
科别:
起搏方式: 无
年龄: 40岁
PNN50: 12
RMSSD: 80
SDSD: 93
SDNN: 162
SDANN: 151
HRVTI: 43
时间(h)

中国民用航空局民用航空医学中心鉴定所

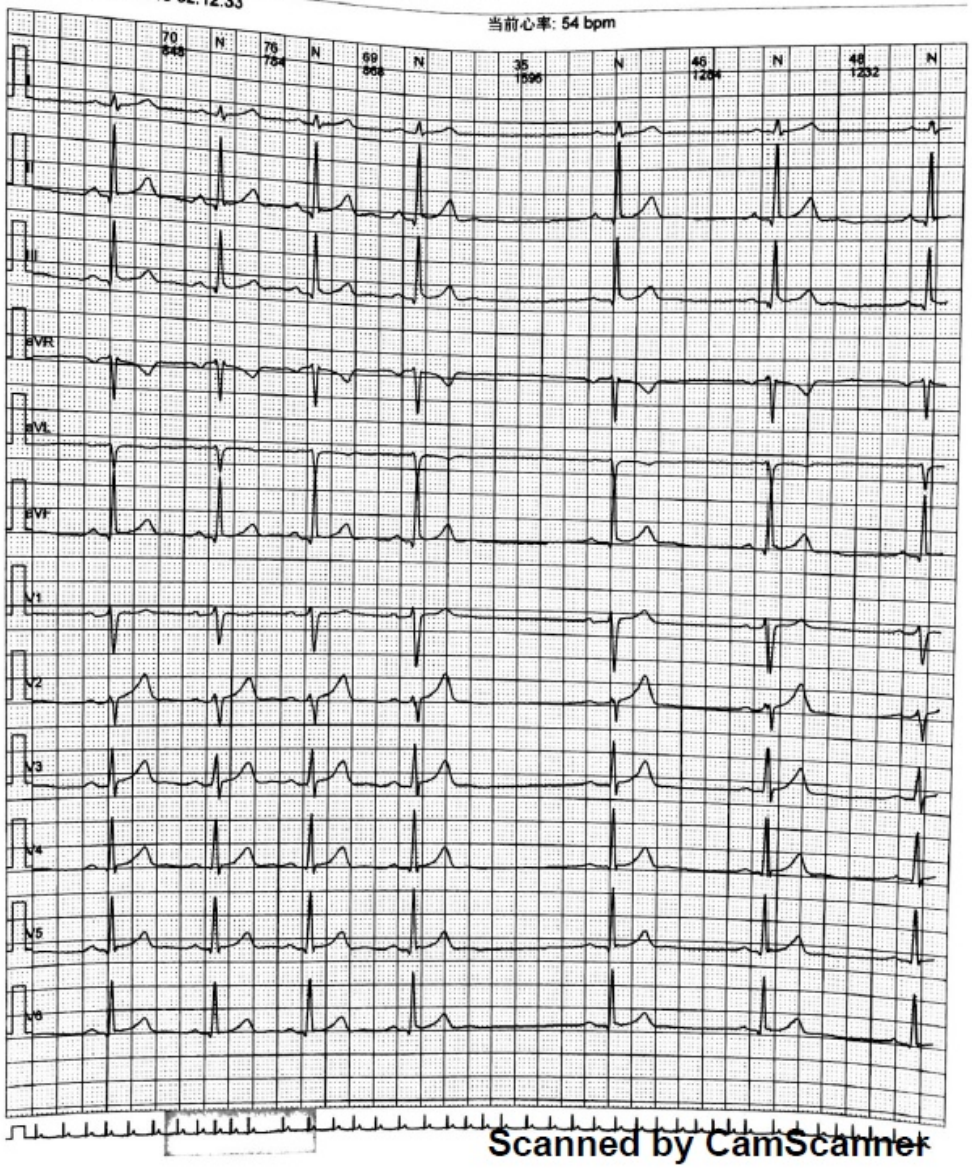
12导同步动态心电图报告

编号:2016111401 门诊号: 科别: 床号: 住院号: 起搏方式: 无

姓名: FRANCOIS 性别: 男 年龄: 40岁 开始时间:2016/11/14 09:54:56

当前时间:2016/11/15 02:12:33

当前心率: 54 bpm



You would conclude :

1.There is now concern

2. with large pool candidates ok to be very conservative

3.Fungal infections make people skittish

4.Take a train when in china

中国民用航空局民用航空医学中心鉴定所

12导同步动态心电图报告

编号:2016111401 门诊号: 科别: 床号: 住院号: 起搏方式: 无

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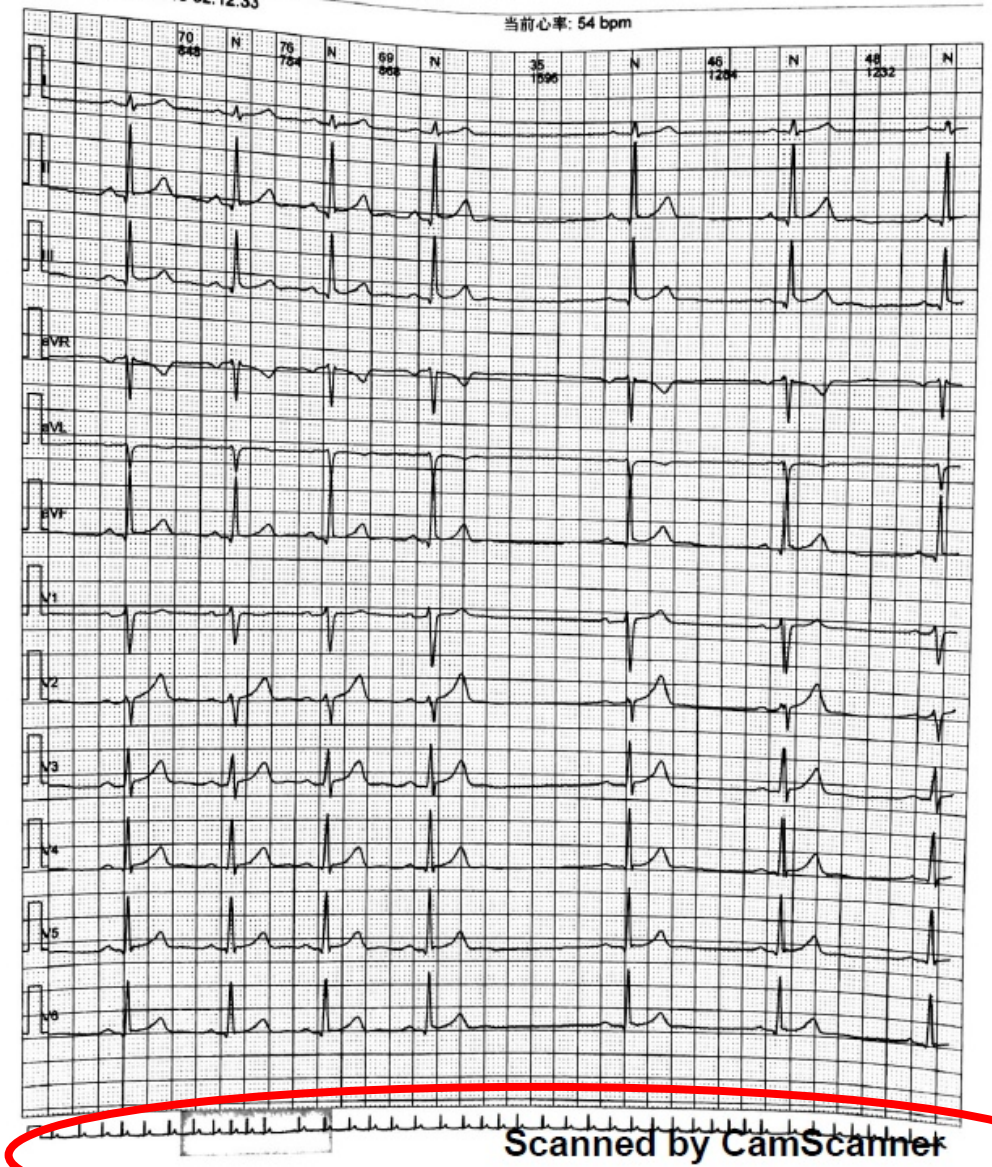
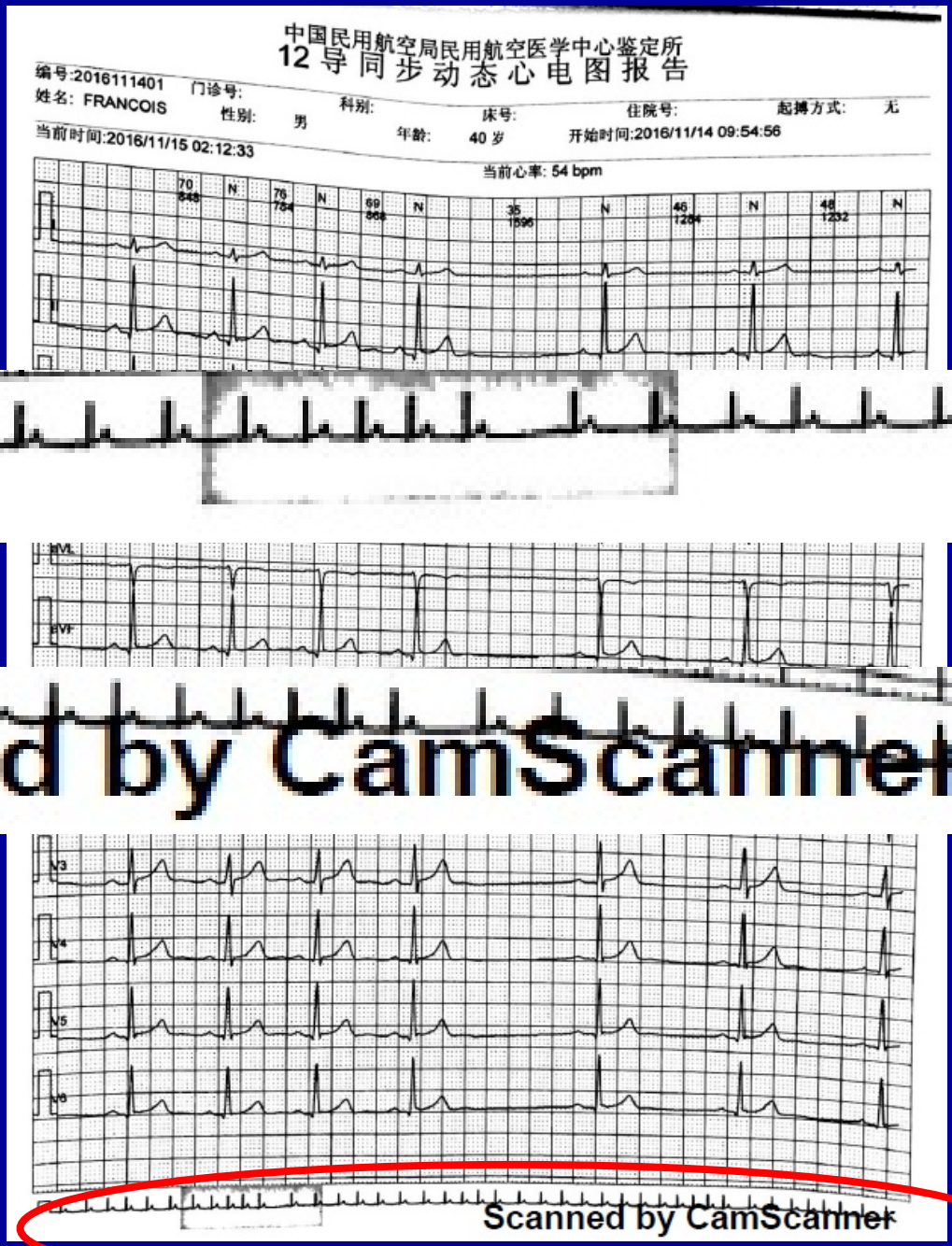
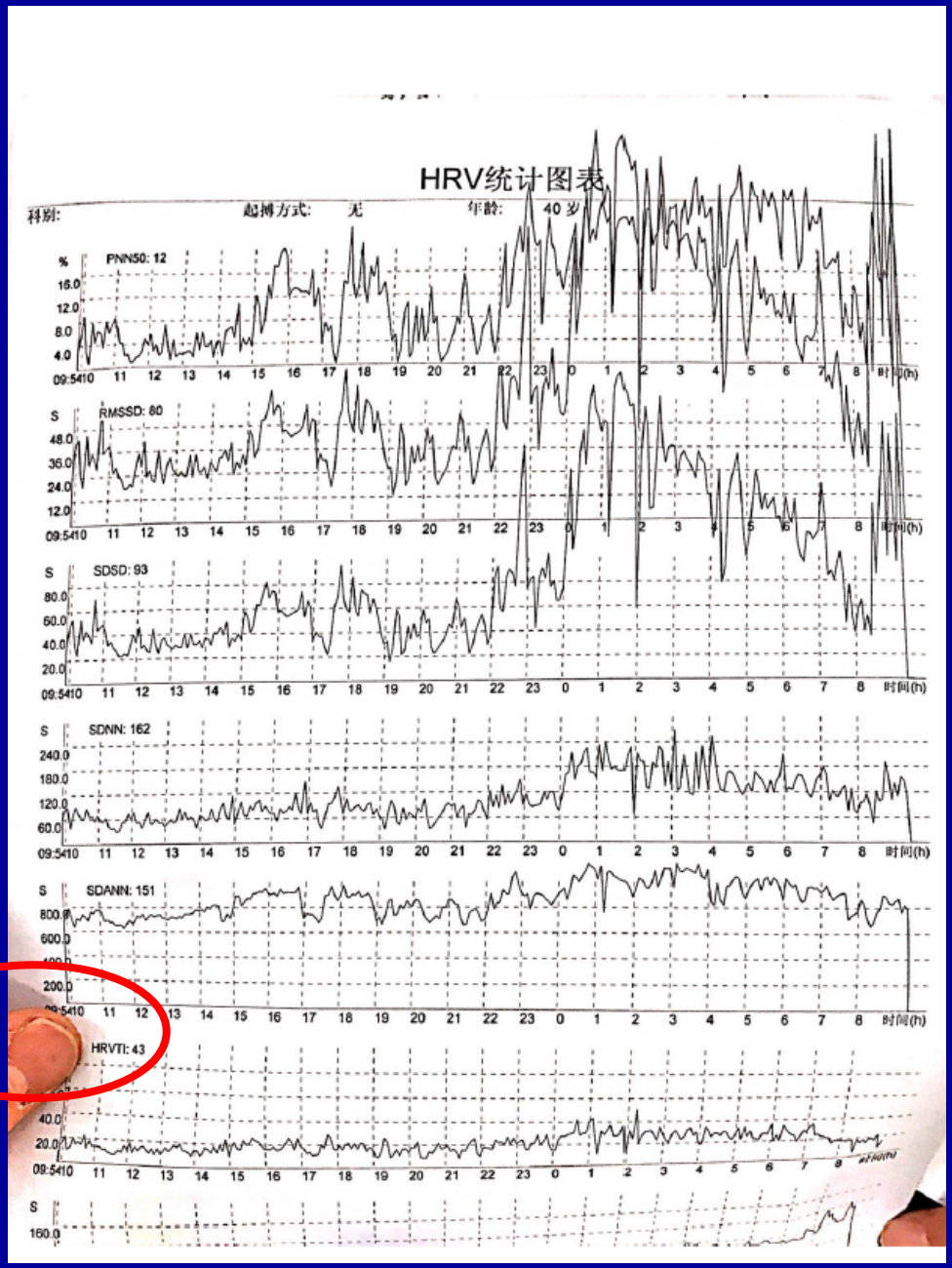
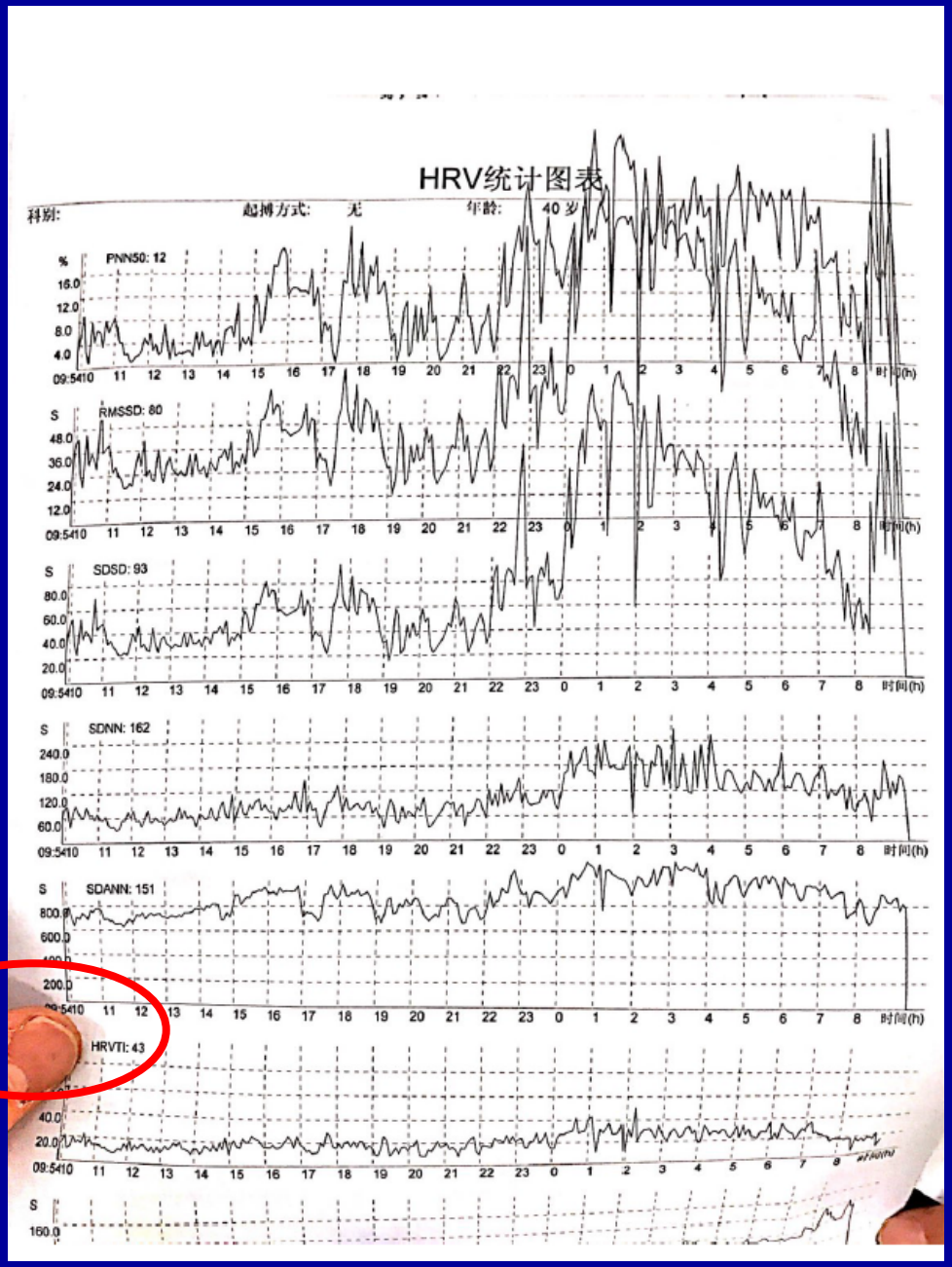
当前时间:2016/11/15 02:12:33

当前心率: 54 bpm




中国民用航空局民用航空医学中心鉴定所
12导同步动态心电图报告
编号:2016111401 门诊号:
姓名: FRANCOIS 性别: 男 科别: 床号: 住院号: 起搏方式: 无
当前时间:2016/11/15 02:12:33 年龄: 40岁 开始时间:2016/11/14 09:54:56
当前心率: 54 bpm
Scanned by CamScanner
Scanned by CamScanner


HRV统计图表
科别:
起搏方式: 无
年龄: 40岁
PNN50: 12
RMSSD: 80
SDSD: 93
SDNN: 162
SDANN: 151
HRVTI: 43
时间(h)


HRV统计图表
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SDSD: 93
SDNN: 162
SDANN: 151
HRVTI: 43
09:5410
时间(h)


09:5410

Holter data stream

HR v time trends :

HRV clinical value modest

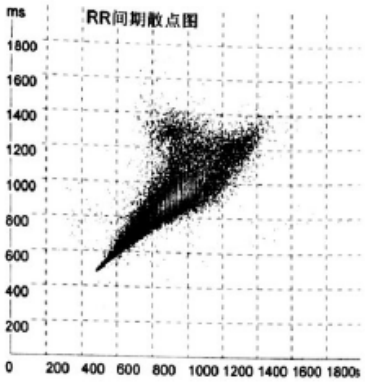
- changes in rate before events
- dysautonomias

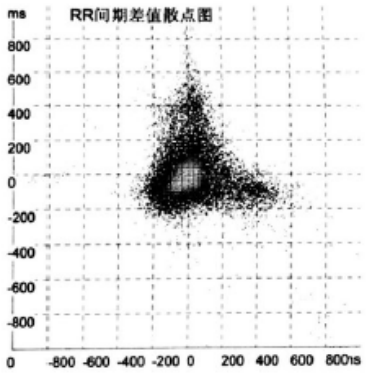
Serial measures of HR v time

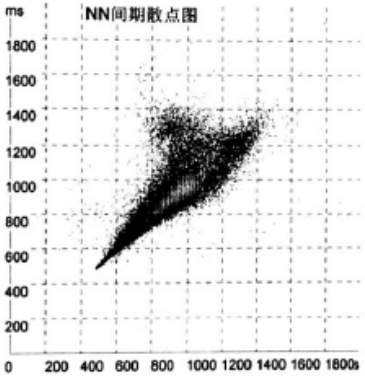
Temporal domain : statistical correlations

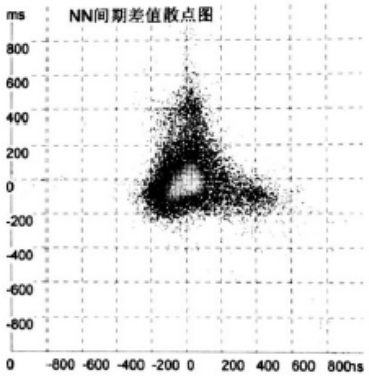
Frequency domain : statistical assumptions

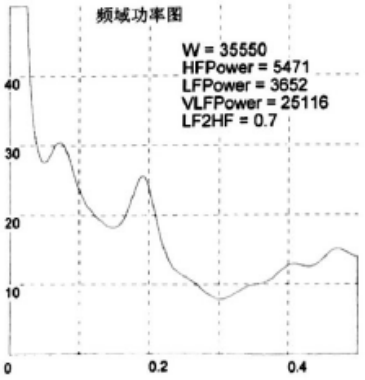
起搏方式: 无 年龄: 40 岁

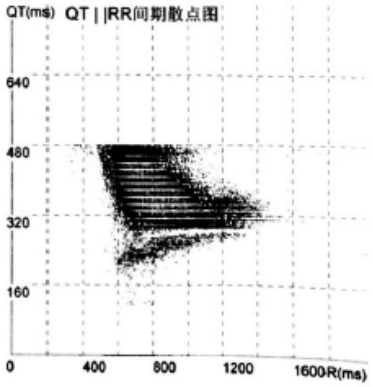

RR间期散点图
ms
1800
1600
1400
1200
1000
800
600
400
200
0 200 400 600 800 1000 1200 1400 1600 1800s

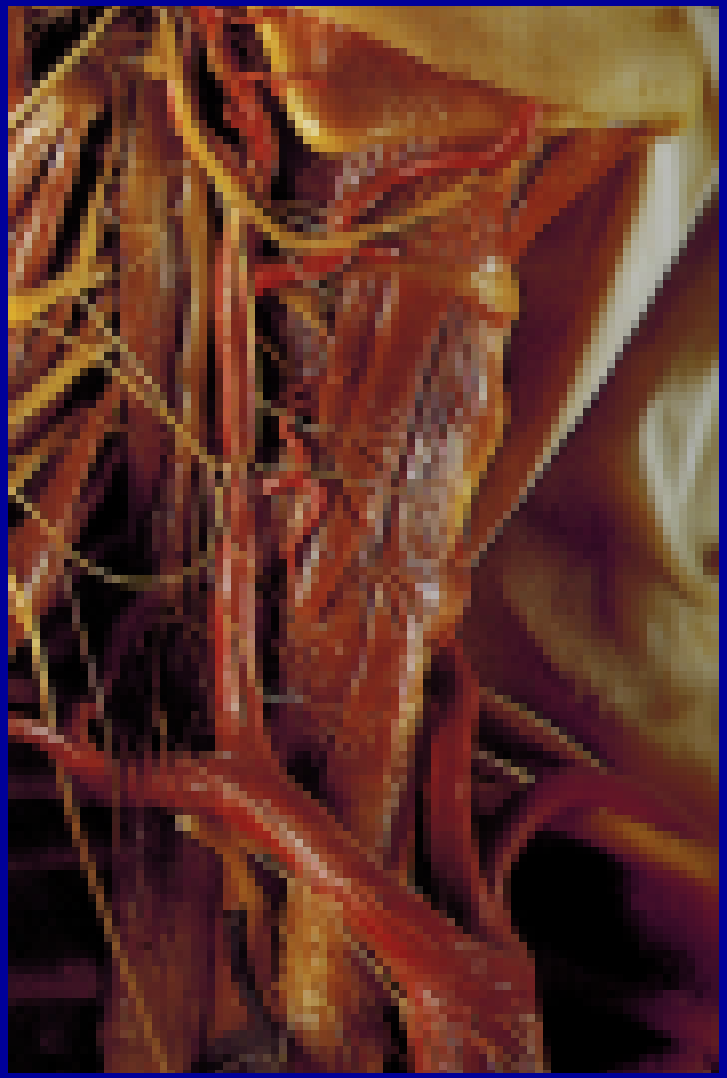

RR间期差值散点图
ms
800
600
400
200
0
-200
-400
-600
-800
0 -800 -600 -400 -200 0 200 400 600 800ms


NN间期散点图
ms
1800
1600
1400
1200
1000
800
600
400
200
0 200 400 600 800 1000 1200 1400 1600 1800s


NN间期差值散点图
ms
800
600
400
200
0
-200
-400
-600
-800
0 -800 -600 -400 -200 0 200 400 600 800ms


频域功率图
W = 35550
HFPower = 5471
LFPower = 3652
VLFPower = 25116
LF2HF = 0.7
40
30
20
10
0
0.2
0.4

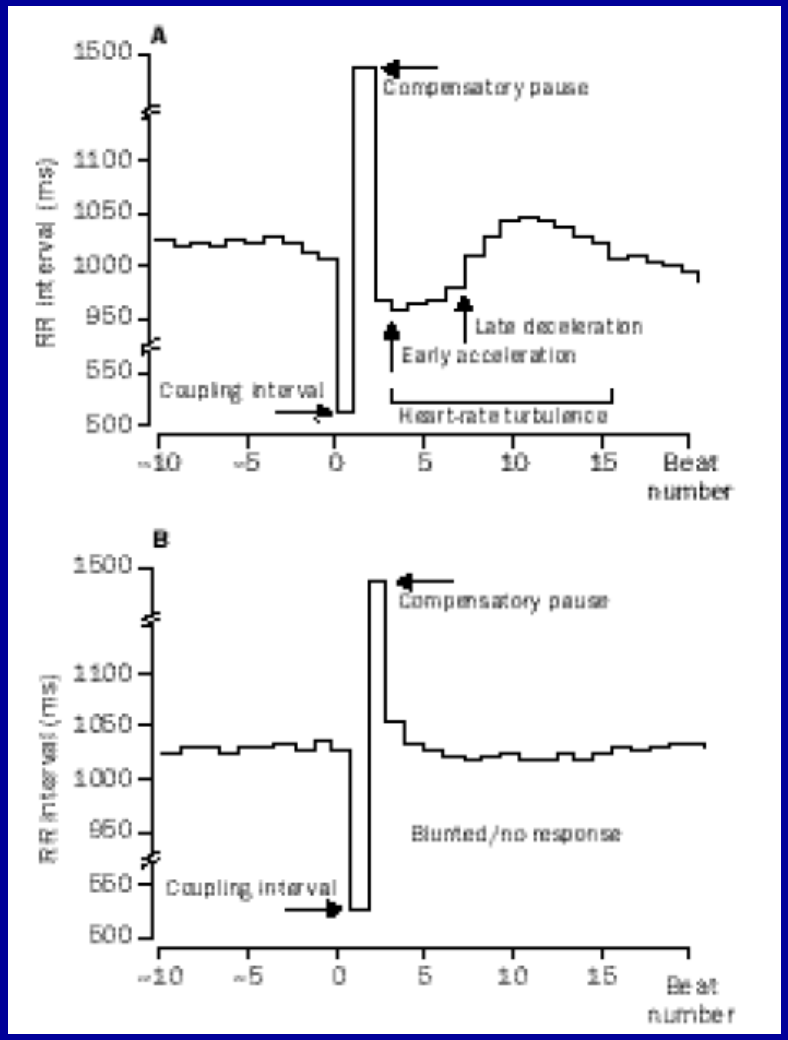

QT(ms) QT | |RR间期散点图
640
480
320
160
0
400
800
1200
1600R(ms)

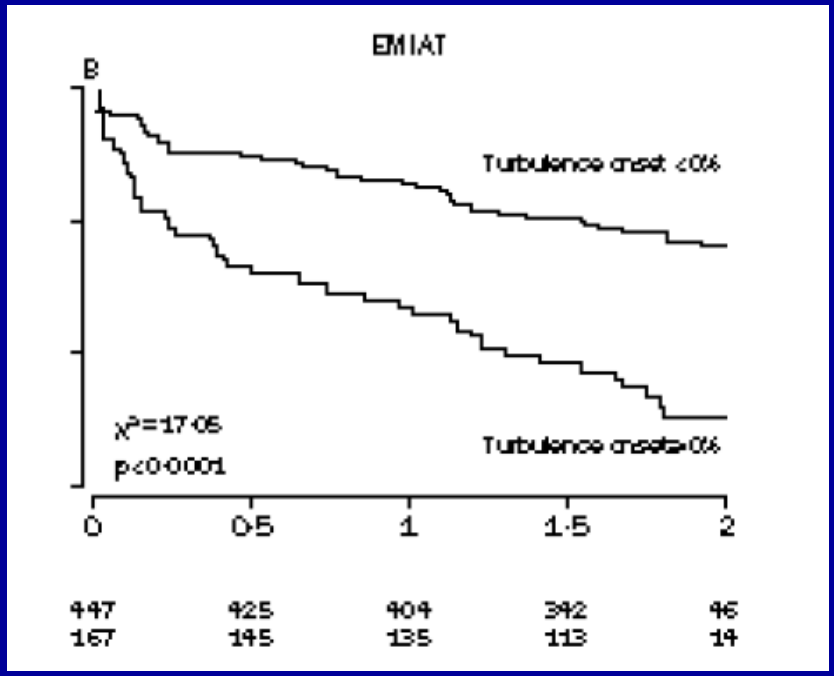


Museo La Specola Florence around 1780

Short term heart rate patterns…..

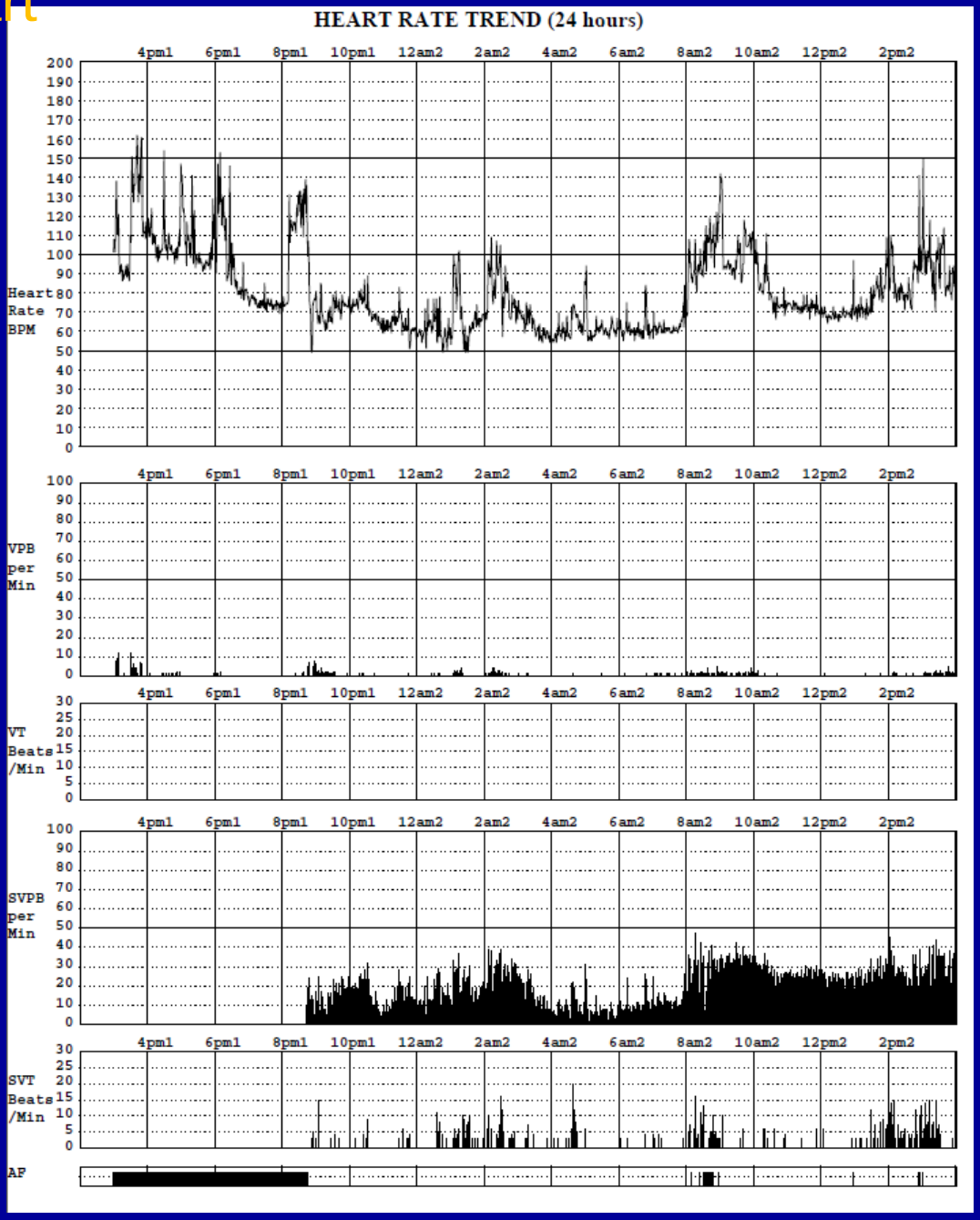
Heart-rate turbulence after ventricular premature beats as a predictor of mortality after acute myocardial infarction





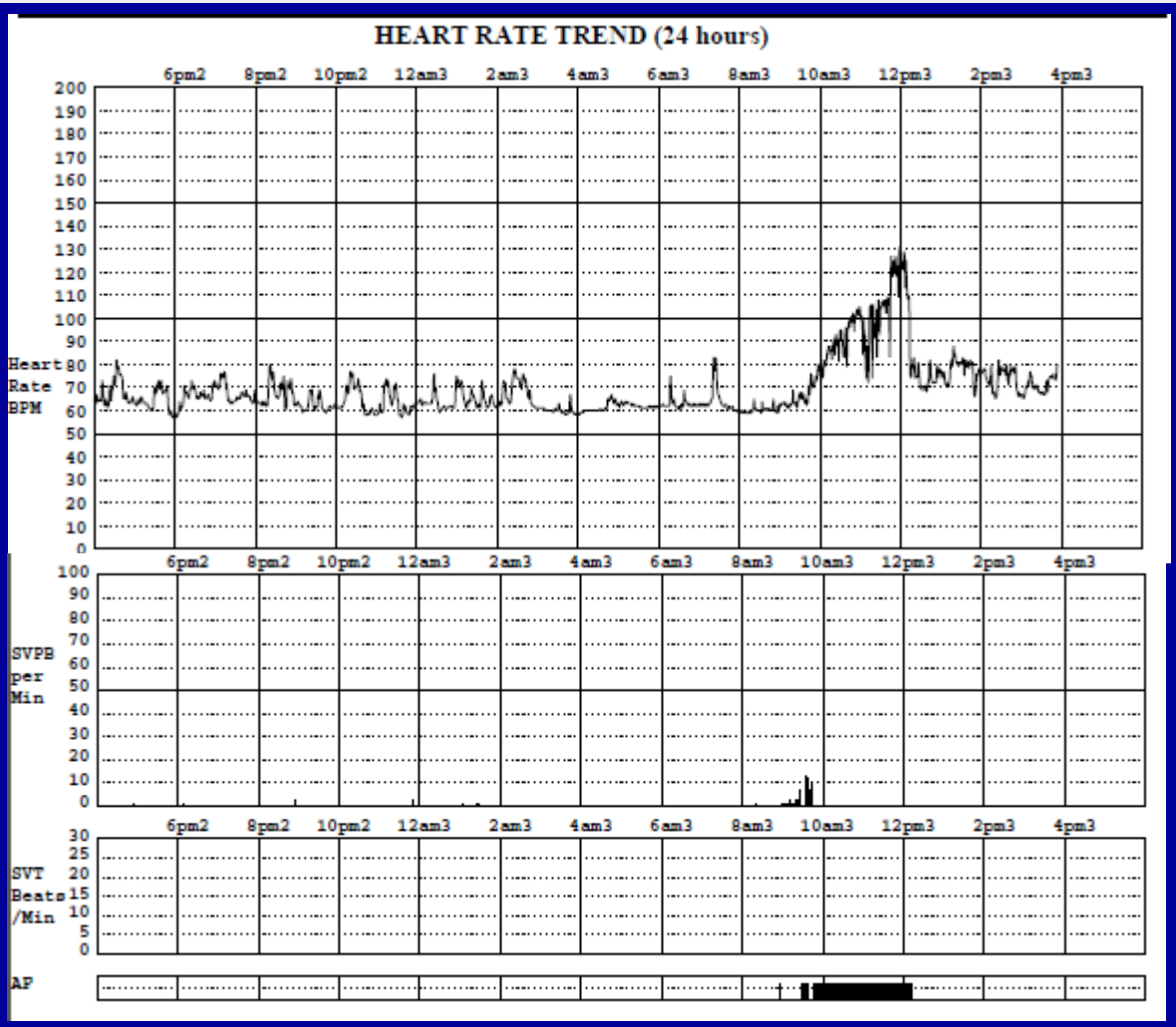
Schmidt Lancet 1999,353:1390

58 yr, PAF normal heart



The patient was monitored for a total of 47:59 hours. The total time analyzed was 47:50 hours. Start time was 4:00pm1. There was a total of 194604 beats. Less than 1% were Ventricular beats, less than 1% were Supraventricular beats, and patient is not paced.

Mean Heart Rate:	68	Total Beats:	194604	
Maximum Heart Rate:	150 @ 11:49am3	Tachycardia beats:	10176 (>=100 BPM)	5%
Minimum Heart Rate:	54 @ 5:54am2	Bradycardia beats:	0 (<= 50 BPM)	0%
Pauses:	0 (> 2.5 sec.)	Longest RR at:	2.072 seconds at 10:16am3	



74, HT
flecainide 50 mg bid
Echo: LAVI 35, e/e'21

Monitoring pill in the pocket pharamco-conversion

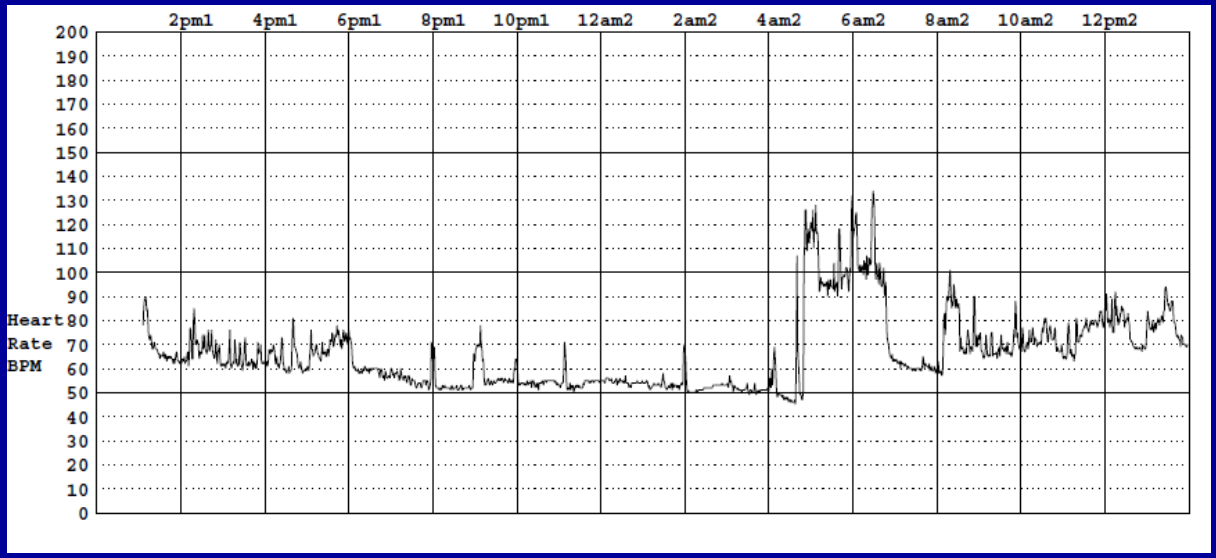
58 yr
No heart disease
PAF despite flecainide P in P
Onto chronic amiodarone
Refused PVI ablation
Took Flecainide on his own

Mean Heart Rate:	64	Total Beats:	155631
Maximum Heart Rate:	166 @ 6:29am2	Tachycardia beats:	8964 (>=100 BPM) 6%
Minimum Heart Rate:	43 @ 4:34am2	Bradycardia beats:	5632 (<= 50 BPM) 4%
Pauses:	0 (> 2.5 sec.)	Longest RR at:	1.5 seconds at 5:53am3

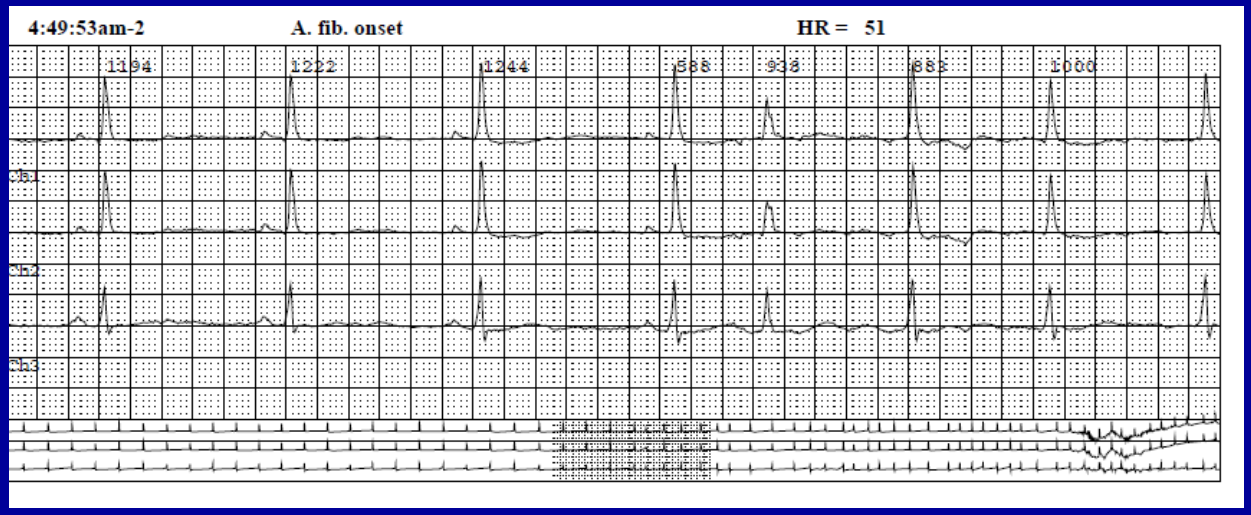
Ventricular Ectopy		Supraventricular Ectopy	
Total:	72	Total:	17
Single:	26	Single:	17
Pairs:	18	Pairs:	0
Total Runs:	1	Total Runs:	0
Beats in Runs:	10	Beats in Runs:	0
Longest Run:	10 @ 4:50am2 (172 BPM)	Longest Run:	0 @ 1:05pm1 (0 BPM)
Fastest Run:	10 @ 4:50am2 (172 BPM)	Fastest Run:	0 @ 1:05pm1 (0 BPM)
RonT:	0	Aberrant:	0

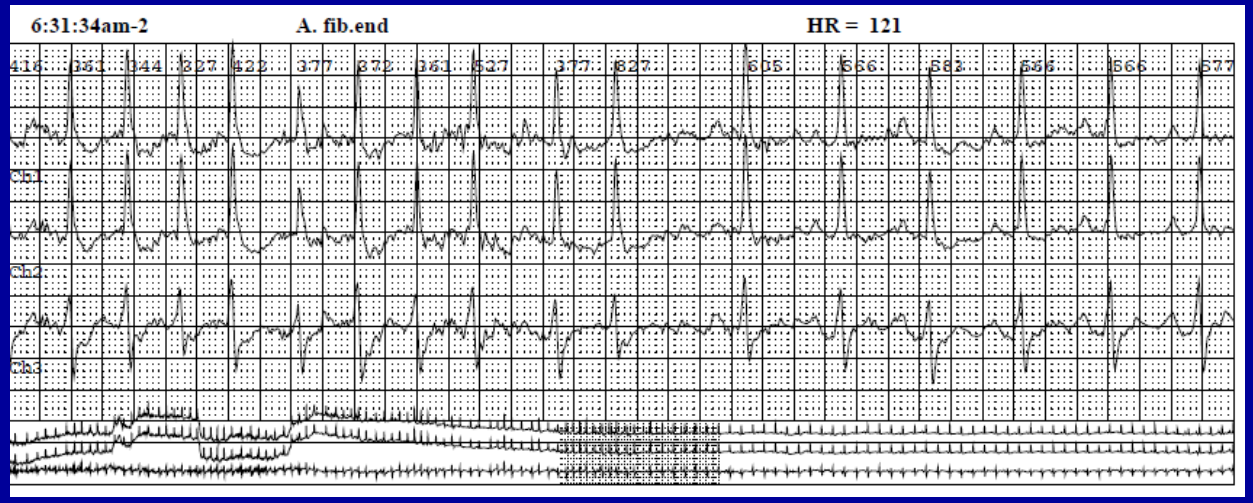
RR Variability		ST Absolute	
SDNN:	181 ms	Depression:	*** mm
pNN50:	6.68 %	Elevation:	*** mm
RMSSD:	48 ms		

A total of 3.31 % time has been labeled as AF (longest run was 1h 42min long).

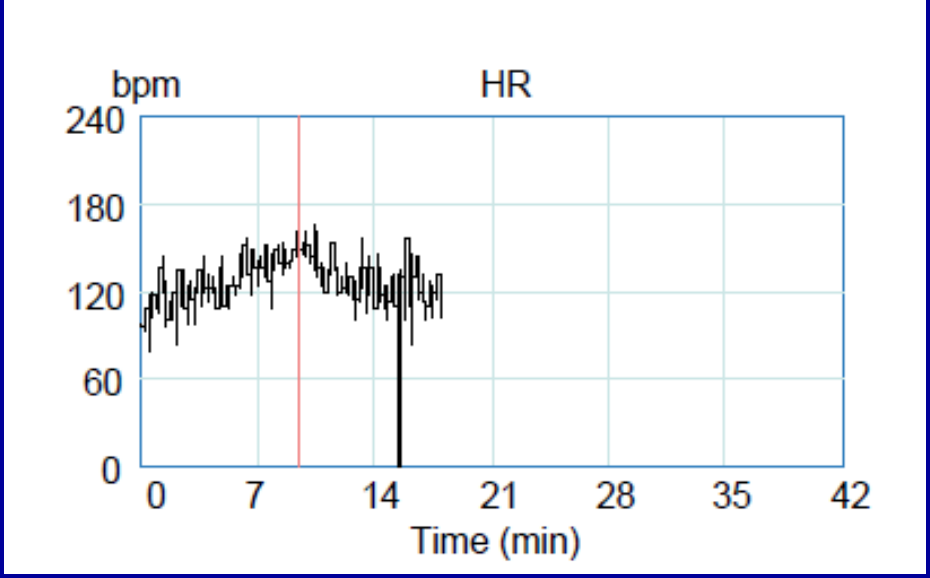


58 yr
No heart disease
PAF despite flecainide P in P
Onto chronic amiodarone
Refused PVI ablation
Took Flecainide on his own





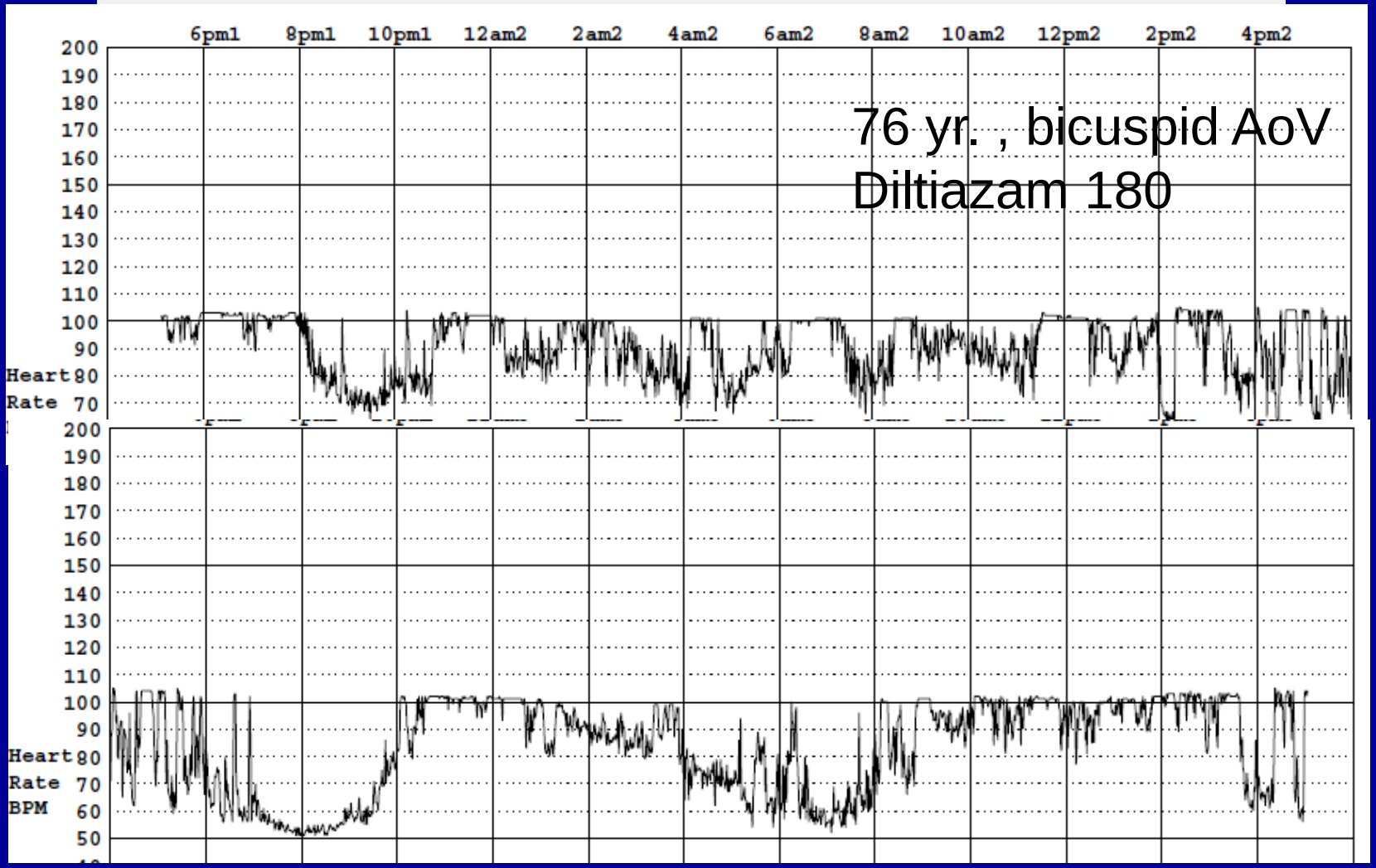
Rate response during exercise in asymptomatic permanent rate controlled atrial fibrillation



Resting HR	97	Target HR	161	Max HR	165	Protocol	Bruce
Resting SBP	120	Max Predicted HR	161	Max SBP	170	HRxBP	28050
Resting DBP	70	% Max HR	102	Max DBP	90	Billing Code	
		Worst-case ST Level	-2.0 II	Total Exercise Time	09:32		
		Worst-case ST Slope	-6 II	METs(a)	10.1		

The patient was monitored for a total of 47:59 hours. The total time analyzed was 47:51 hours. Start time was 5:06pm1. There was a total of 251021 beats. There were 0 Ventricular beats, there were 0 Supraventricular beats, and patient is not paced.

Mean Heart Rate:	87	Total Beats:	251021
Maximum Heart Rate:	112 @ 5:52pm1	Tachycardia beats:	10953 (>=100 BPM) 44%
Minimum Heart Rate:	46 @ 6:46am3	Bradycardia beats:	305 (<= 50 BPM) 0%
Pauses:	33 (> 2.5 sec.)	Longest pause:	3.244 seconds at 8:42pm2



HR trends in afib rate management

Goal is average < 90 bpm (CCS 2014)

% > 100 bpm < 20-25%

symptoms over rate

Daytime pauses: napping schedule

Significant night pauses: r/o OSA

Symptomatic rate controlled = consider NSR

AVJ ablation treats both rate and irregularity

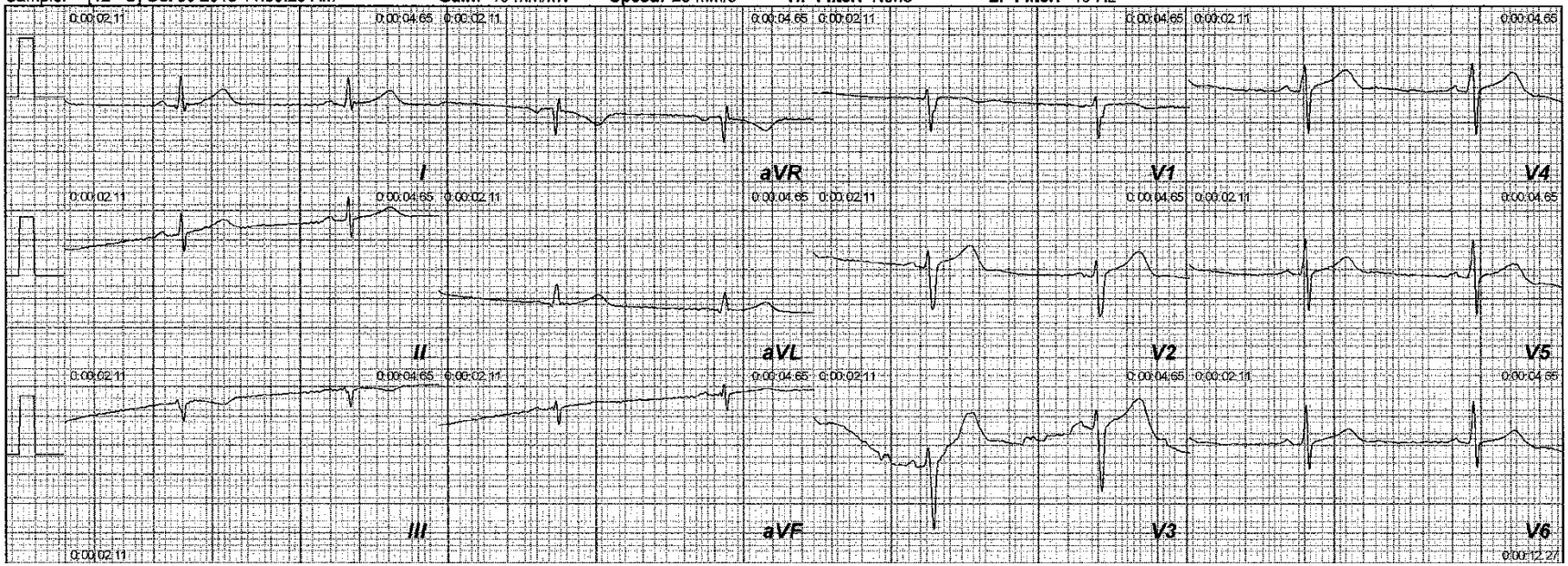
EF is RATE dependent, LV diameter *and* EF

12 Lead ECG Report

Report Date: Nov 01 2013
ECG Date/Time: Oct 30 2013 11:50:29 AM

Recorded by:	CMD, Office_S	**Patient:**	Joseph Gary	**Rate:**	51bpm	**PR:**	0.138 S
Reporting MD:	CMD, Office_S	**Health ID:**		**QRS:**	0.090 S	**QT:**	0.454 S
Referring MD:	--	**Date of Birth:**	Feb 20 1973(40yrs)	**QTc:**	0.419 S	**QRS Axis:**	-7
Inst. ID/Location:	--/--	**Gender:**	MALE				
Interpretation:	Sinus bradycardia Normal morphology						

Sample: -- [12 - U] Oct 30 2013 11:50:29 AM **Gain:** 10 mm/mV **Speed:** 25 mm/s **HP Filter:** None **LP Filter:** 40 Hz



HOLTER MONITOR REPORT

Patient Name:	DN-S Wise, Joseph G	Physician:	David Newman
Date of Birth:	2/20/1973	Scan Number:	2013-10-21 11:33
ID #:	8574084359	Date Recorded:	10/18/2013
Age:	40 Years	Date Processed:	10/21/2013
Sex:	M	Recorder Num:	007015
Analyst:	IK	HookupTech:	MT
Interp.Physician:	David Newman	Height:	0 -- Weight: 0 -- BMI: 0
Indications:	Rhythm assessment	Medications:	

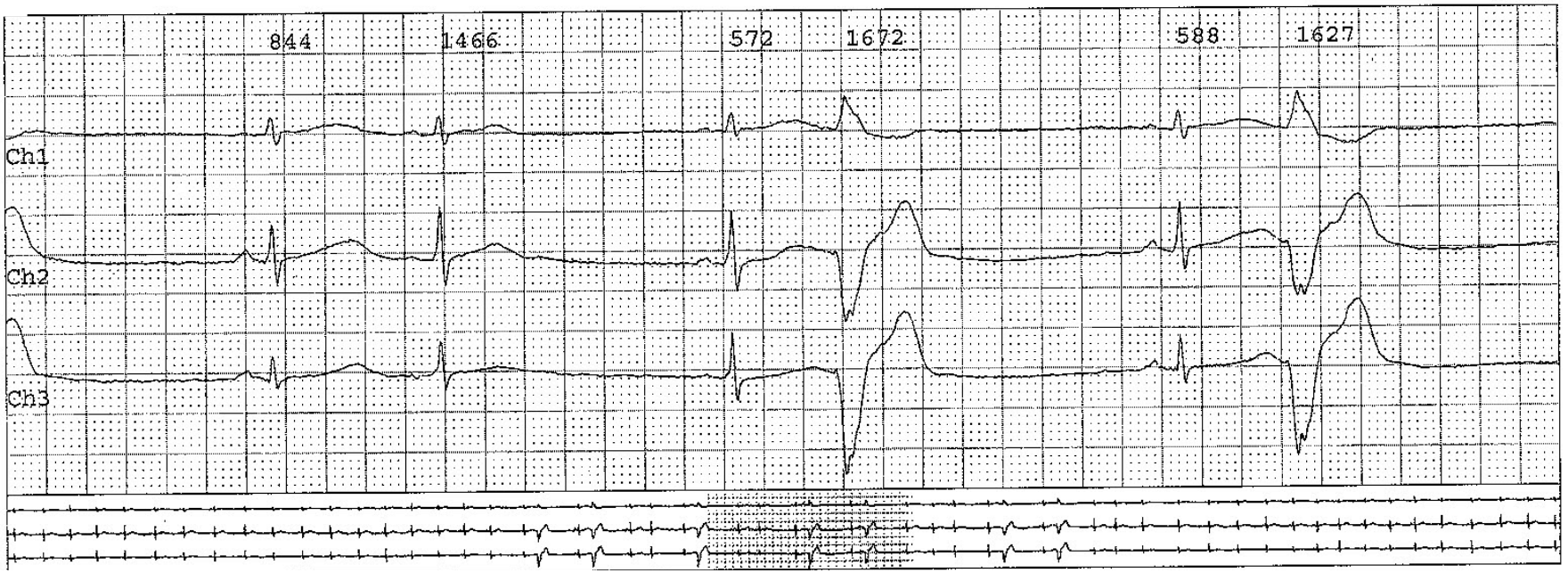
DN-S Wise, Joseph G was monitored for a total of 47:59 hours. The total time analyzed was 46:32 hours. Start time was 2:26PM1. There were a total of 172239 beats. Less than 1% were Ventricular beats, less than 1% were Supraventricular beats.

Mean Heart Rate: 62
Maximum Heart Rate: 102 at 10:50:25PM1
Minimum Heart Rate: 40 at 6:18:21AM2
Pauses: 0 (Greater than 2.5 sec.)

Ventricular Ectopy		Supraventricular Ectopy	
Total:	196	Total:	338
Single:	191	Single:	333
Pairs:	2	Pairs:	1
Total Runs:	0	Total Runs:	1
Beats in Runs:	0	Beats in Runs:	3
#beats	@ rate	#beats	@ rate
Longest Run:	0@ 2:26PM1 0	Longest Run:	3 @ 2:43PM1 158
Fastest Run:	0@ 2:26PM1 0	Fastest Run:	3 @ 2:43PM1 158
RonT:	1	Aberrant:	0

RR Variability		ST Absolute	
SDNN:	180 ms	Depression:	*** mm
pNN50:	25.02 %	Elevation:	*** mm
RMSSD:	102 ms		

5:47:36AM3 **Quadrigeminy** **HR = 56**



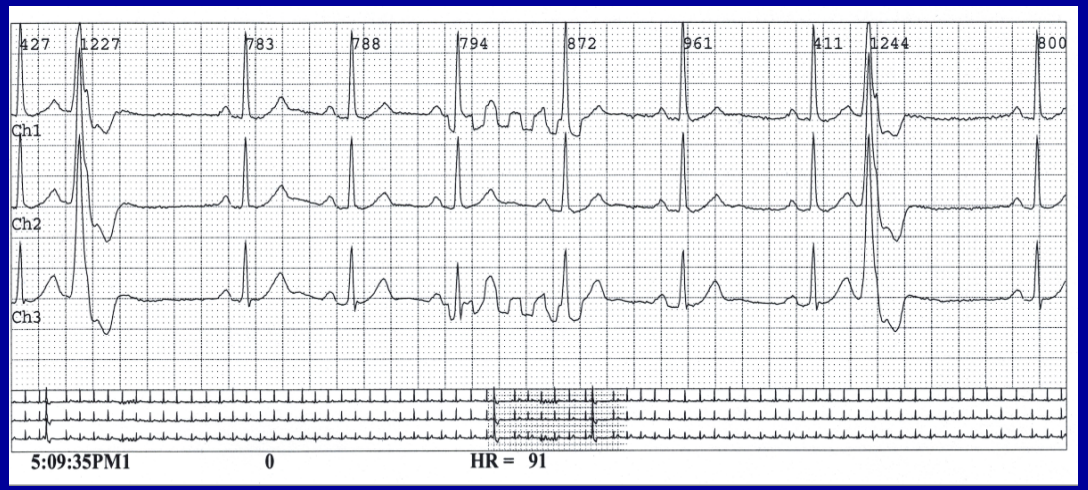
RVOT/VPB drug management

Mean Heart Rate:	68	Total Beats:	194436
Maximum Heart Rate:	135 @ 2:46pm3	Tachycardia beats:	3446 (>=100 BPM) 2%
Minimum Heart Rate:	46 @ 5:08am3	Bradycardia beats:	399 (<= 50 BPM) 0%
Pauses:	0 (> 2.5 sec.)	Longest RR at:	1.539 seconds at 10:35am2

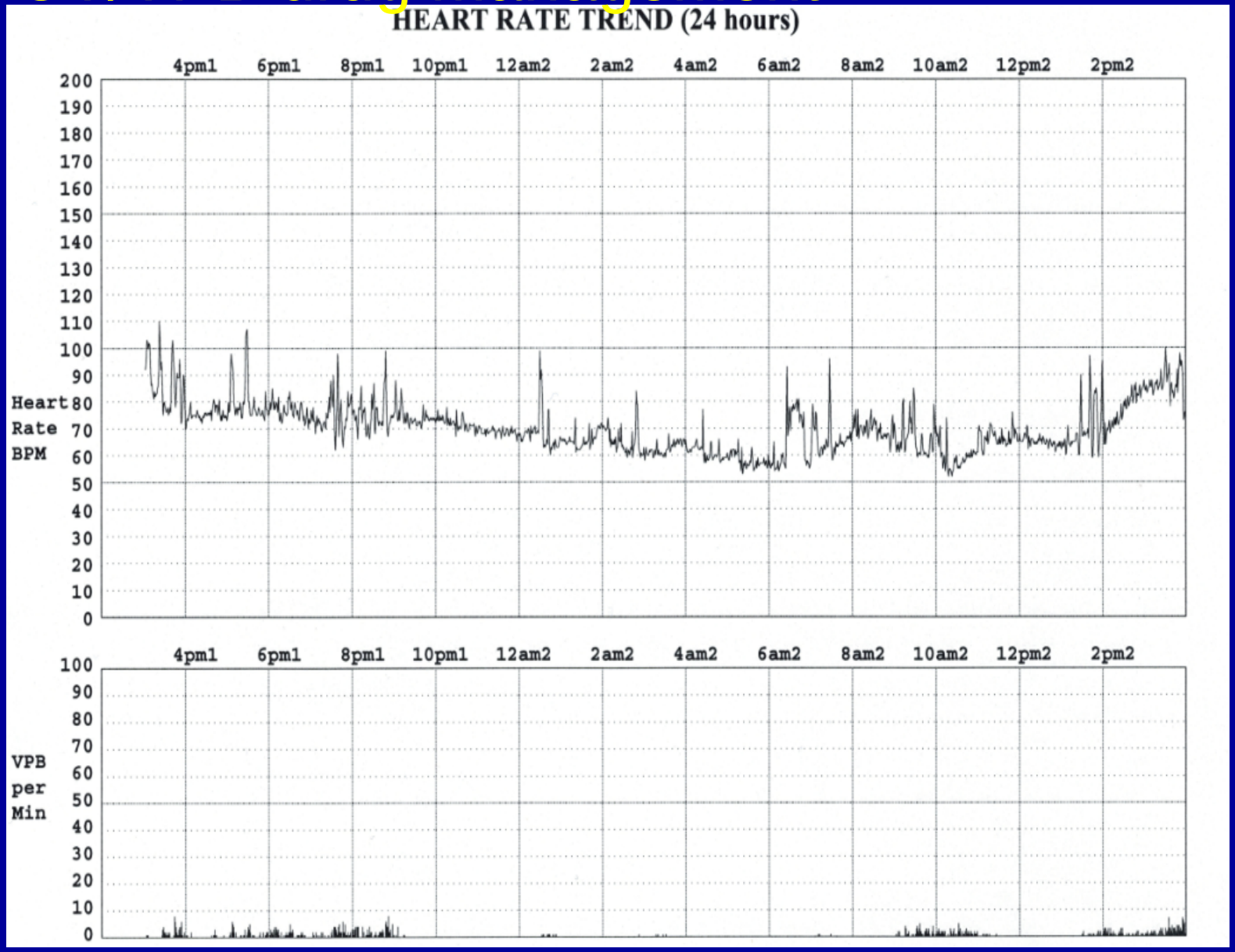
Ventricular Ectopy		**Supraventricular Ectopy**	
Total:	1076	Total:	14
Single:	1068	Single:	14
Pairs:	0	Pairs:	0
Total Runs:	0	Total Runs:	0
Beats in Runs:	0	Beats in Runs:	0
Longest Run:	0 @ 3:02pm1(0 BPM)	Longest Run:	0 @ 3:02pm1(0 BPM)
Fastest Run:	0 @ 3:02pm1(0 BPM)	Fastest Run:	0 @ 3:02pm1(0 BPM)
RonT:	8	Aberrant:	0

RR Variability		**ST Absolute**	
SDNN:	132 ms	Depression:	*** mm
pNN50:	10.39 %	Elevation:	*** mm
RMSSD:	35 ms		

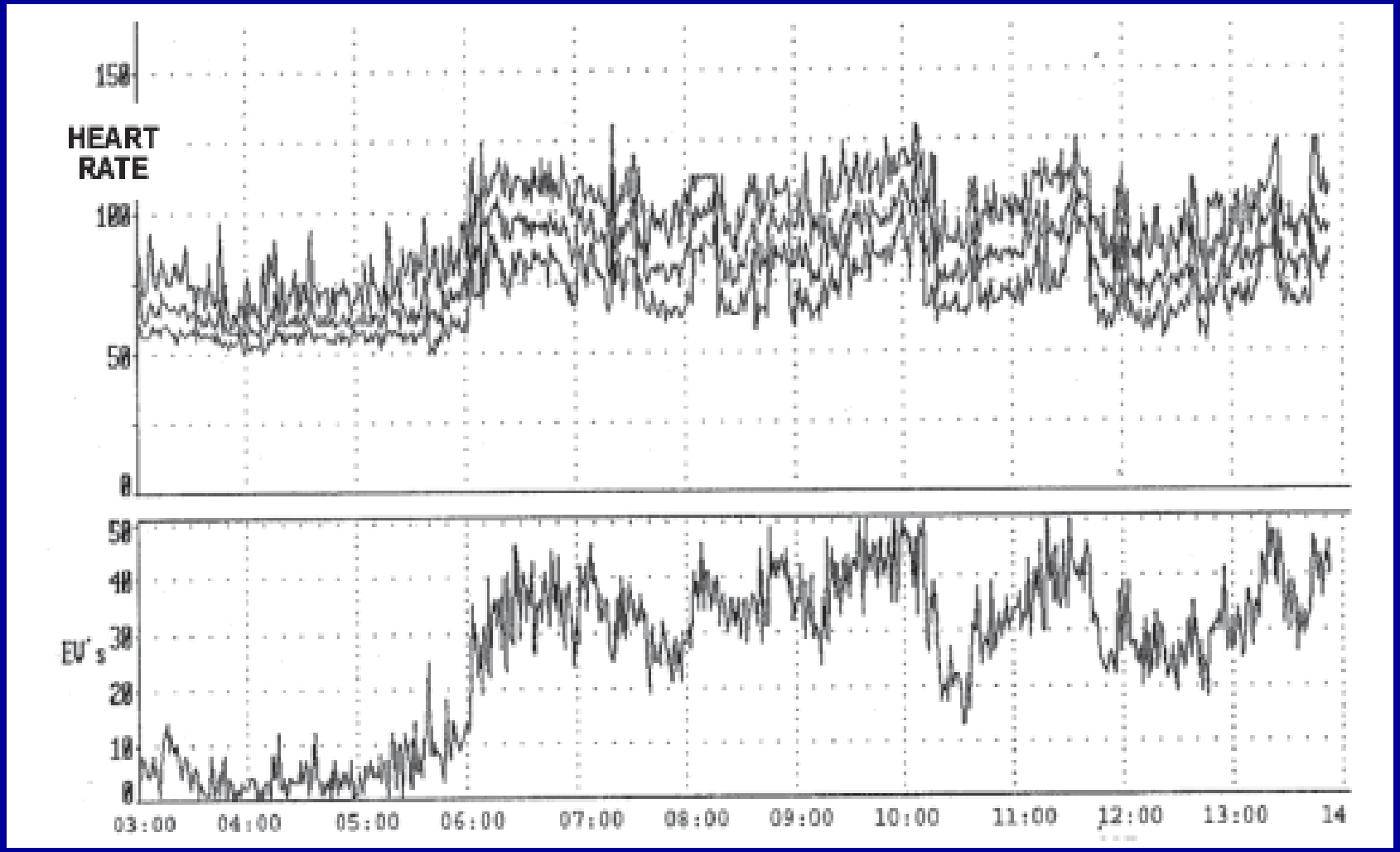
COMMENTS: There were 314 event activation mostly corresponded to isolated PVC's.



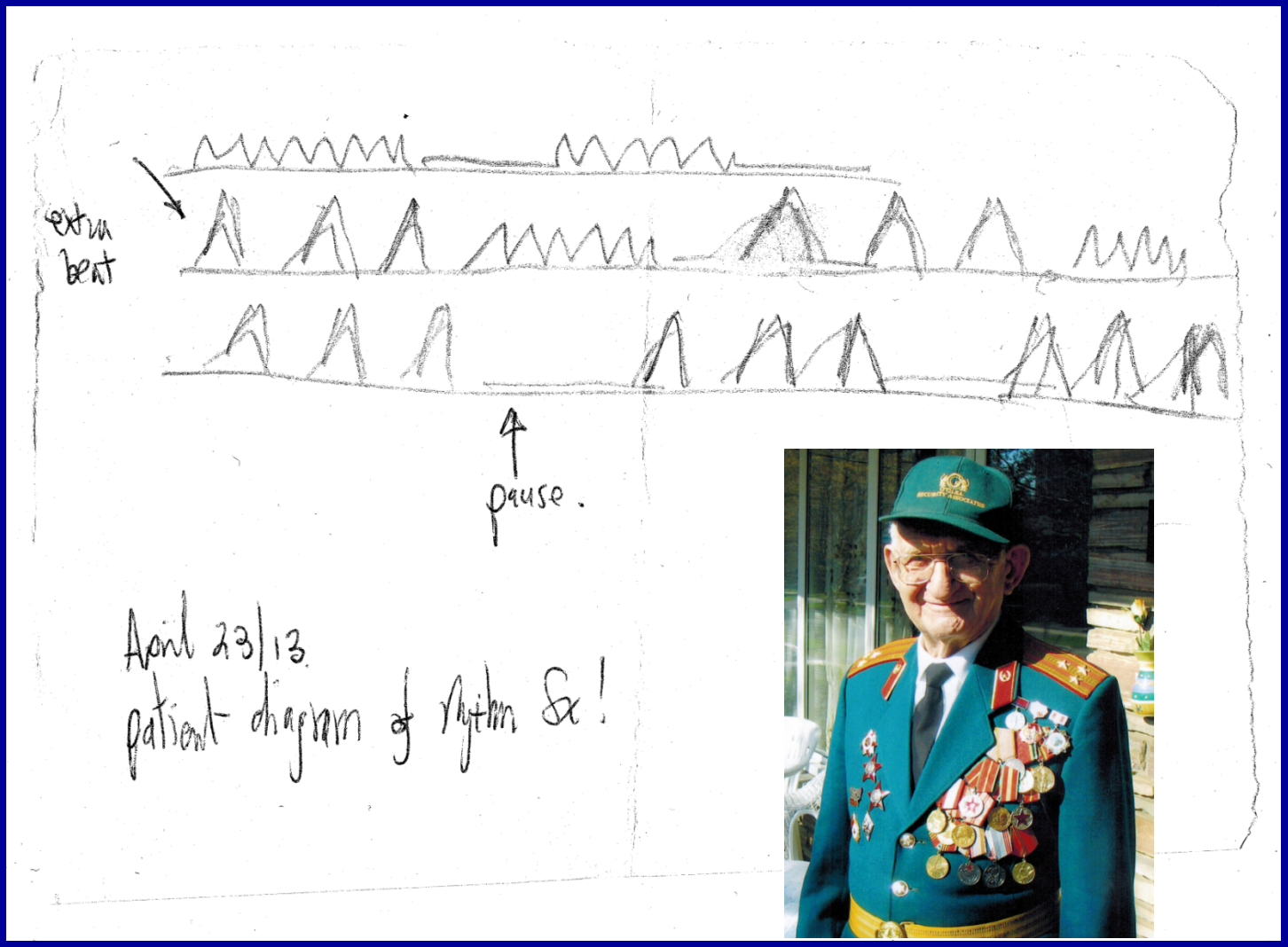
RVOT/VPB drug management



RVOT/VPB drug management



The future : Presumed atrial fibrillation



Can afib be presumed?

24h Holter Surrogate predictors of atrial fib in secondary stroke

>100 APB/h, based on 32s od x 30 OD (n=98, 9% afib)

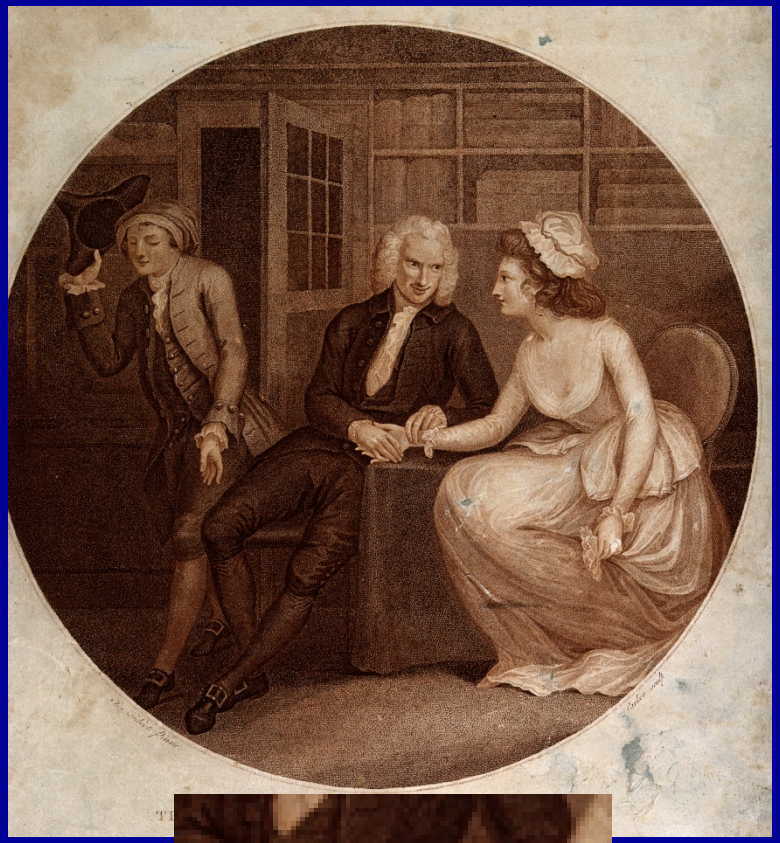
Gaillard, Neurol 74:1666,2010

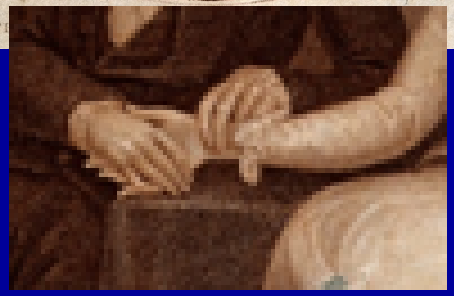
- 70 APB/h, based on 3 x 7 d holter (n=127,26% afib, OR 6.6)

Wallmann Stroke 38:229, 2007

- EMBRACE trial of 30d auto ELR :
- >100 APB/h identified 28% of afib , (20% afib)
- >75 APB/h identified 20% of afib

Low tech: taking a pulse





Meserschmidt bust to illustrate boredom, 1750