A Case Of an Athlete With A Pacemaker who Cannot Exercise To His Maximum

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Case History

- 43 yrs old man , an amateur athlete

- DDDR(Enrythm) implanted 1yr ago for 2:1 AV block (developed 4 yrs after surgical correction of congenital PV stenosis)

- Complains of sudden weakness when he performs his regular jogging

Pacemaker programming

Device: **EnRhythm P1501DR**
Serial Number: **PNP465977H**

Initial Interrogation: Quick Look   Page 1

Device Status (Implanted: 24-Feb-2009)   Measured on:

Battery Voltage (ERI=2.59 V)		3.00 V	01-Feb-2010
	Atrial	**RV**	
Lead Impedance	368 ohms	488 ohms	01-Feb-2010
Programmed Amplitude/Pulse Width	2 V / 0.4 ms	2.5 V / 0.4 ms	
Measured P/ R Wave	3.5 mV	- - -	01-Feb-2010
Programmed Sensitivity	2.1 mV	0.9 mV	

Parameter Summary

Mode	DDD	Lower Rate	50 bpm	Paced AV	150 ms
Mode Switch	171 bpm	Upper Track	150 bpm	Sensed AV	120 ms
		Upper Sensor	150 bpm		

Detection		Rates	Therapies
AT/AF	Monitor	>171 bpm	All Rx Off
VT	Monitor	>176 bpm	

Pacemaker programming

Device: **EnRhythm P1501DR**
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Parameters   **Page 2**

Refractory/Blanking

PVARP	270 ms
PVAB Interval	150 ms
PVAB Method	Partial
A. Blank Post AP	200 ms
A. Blank Post AS	100 ms
V. Blank Post VP	200 ms
V. Blank Post VS	120 ms

Additional Features

Non-Comp Atrial Pacing	On
NCAP Interval	300 ms
PMT Intervention	On
PVC Response	On
V. Safety Pacing	On

Device Information

Device	Medtronic	EnRhythm P1501DR	PNP465977H	Implanted: 24-Feb-2009

On interrogation : Multiple AF episodes

Device: **EnRhythm P1501DR**
Serial Number: **PNP465977H**

Date of Visit: **01-Feb-2010 11:35:32**
9987 Software Version 7.0
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Initial Interrogation: AT/AF Summary   Page 2

Since Last Session 24-Sep-2009 to 01-Feb-2010

AT/AF Durations	Episodes	AT/AF Start Times	Episodes
>72 hr	0	09:00 - 12:00	940
48 hr to 72 hr	0	12:00 - 15:00	188
24 hr to 48 hr	0	15:00 - 18:00	94
12 hr to 24 hr	0	18:00 - 21:00	683
4 hr to 12 hr	0	21:00 - 00:00	45
1 hr to 4 hr	0	00:00 - 03:00	0
10 min to 1 hr	0	03:00 - 06:00	0
1 min to 10 min	20	06:00 - 09:00	84
<1 min	2,014		

Vast majority cluster around the same time

When he uses to exercise
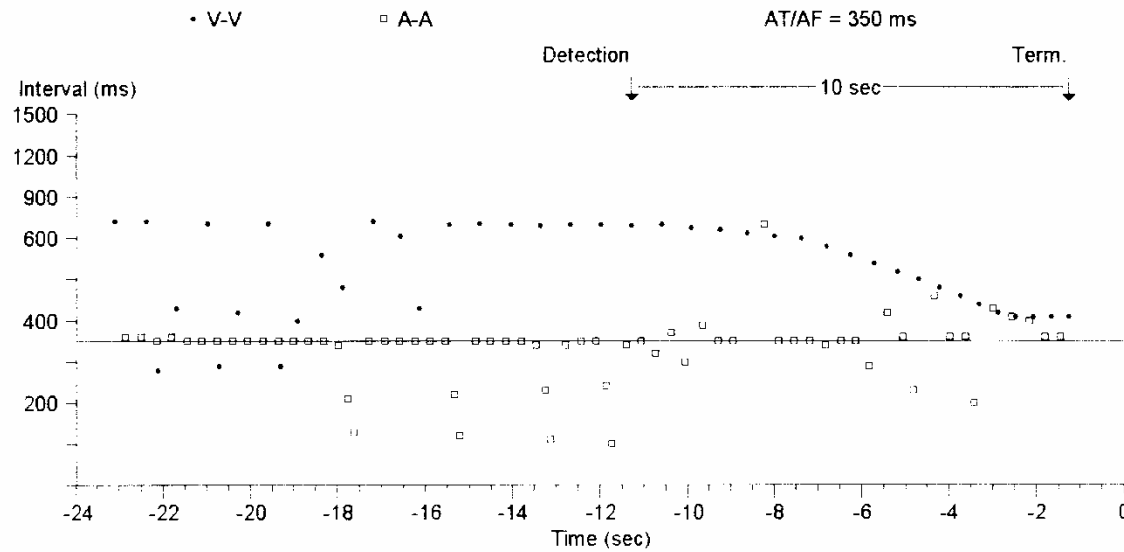
Almost all episodes last < 1 min

A Typical episode

Date of Visit: **01-Feb-2010 11:35:32**
9987 Software Version 7.0

Device: **EnRhy___01DR**
Serial Number: ___977H

Monitored AT/AF Episode #1136   Page 1

Type	ATP Seq	Success	ID#	Date	Time hh:mm	Duration hh:mm:ss	Avg bpm A/V
AT/AF			1136	30-Jan-2010	11:24	:10	164/110

• V-V   □ A-A   AT/AF = 350 ms

A-A interval is fairly stable

First Impression

The time association with daily exercise and the typical acceleration of rate toward the mode switch is very suggestive of either sinus tachycardia causing mode switching or true AF during exercise
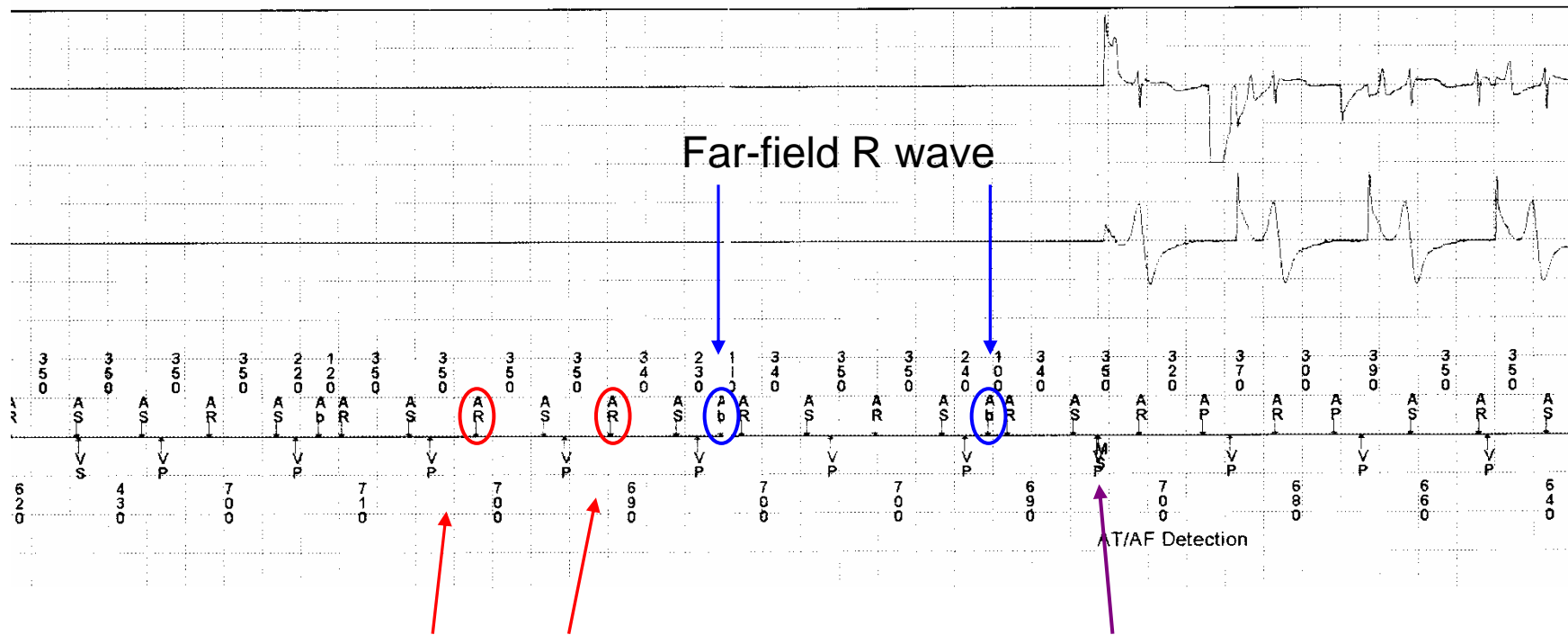
A stored episode
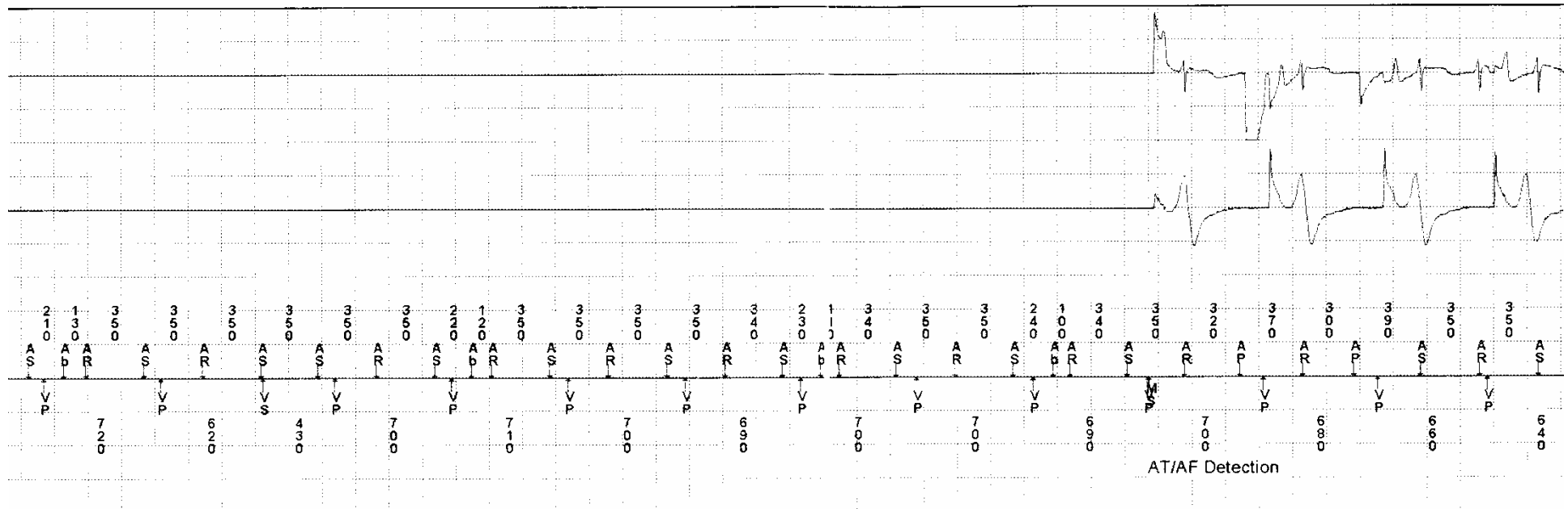
How do you interpret this strip ?

Interpretation

- During exercise sinus rate approaches 175
- TARP results in AR on every second sinus beat above rate with a sudden drop in ventricular pacing rate ....
- Soon thereafter , Sinus beats (AS + AR) + far field R wave sensing cause AMS
- Take another look …

Far-field R wave

AA interval < TARP

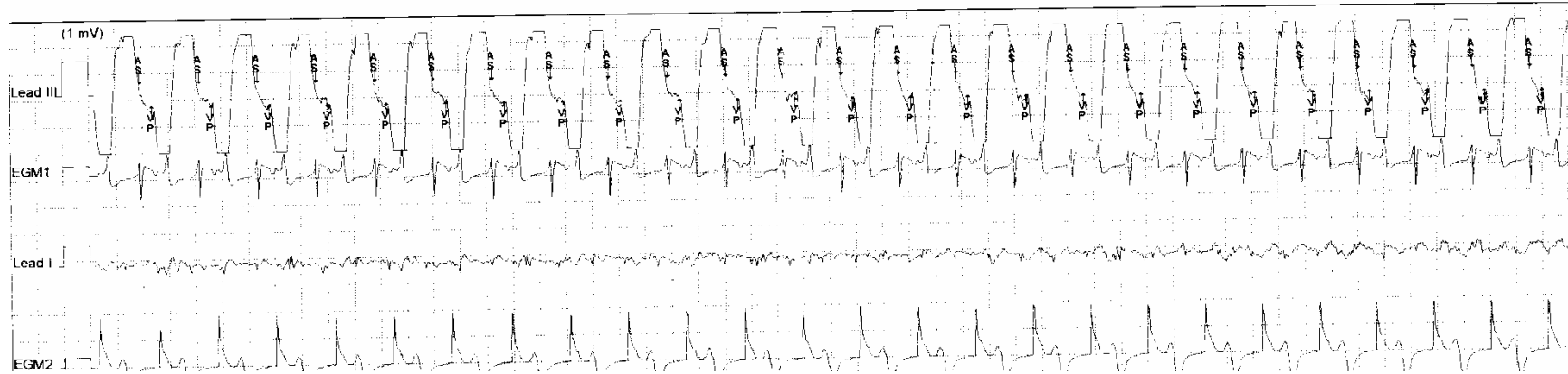results in 2:1 conduction

Short AA interval + FFRW

cause AMS

AT/AF Detection

The median of the last 12 atrial intervals must be less than the programmed AT/AF detection interval for AT/AF detection to occur.

We performed exercise testing …

1:1 AV conduction

When exercise continued we observed the following …

EnRhythm P1501DR   01-Mar-2010 09:55:50

CHAR

.2 mV/mm

ing 0.5 mV/mm
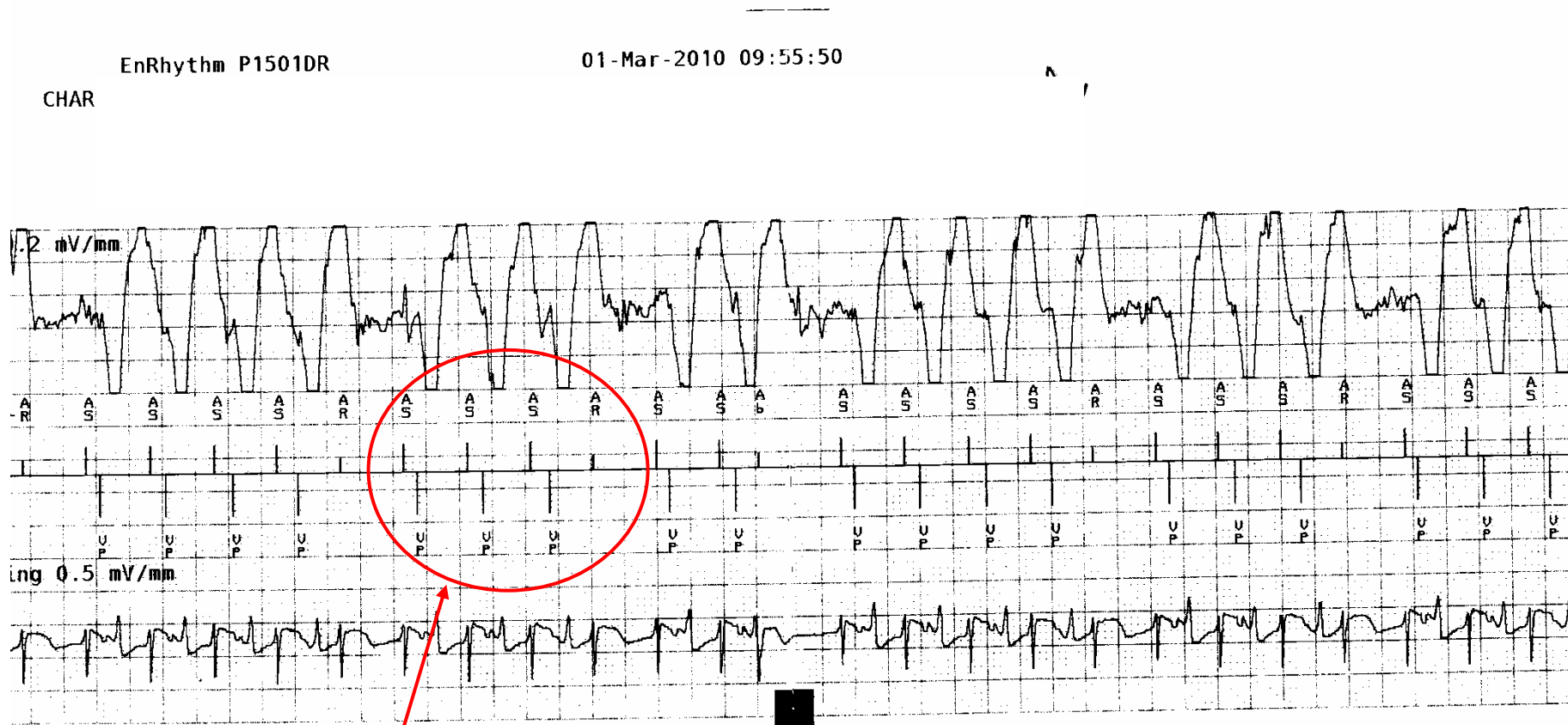
Sinus rate exceeding MTR interval results in Wenckebach (In
Enrythm maximum available MTR is 150bpm)

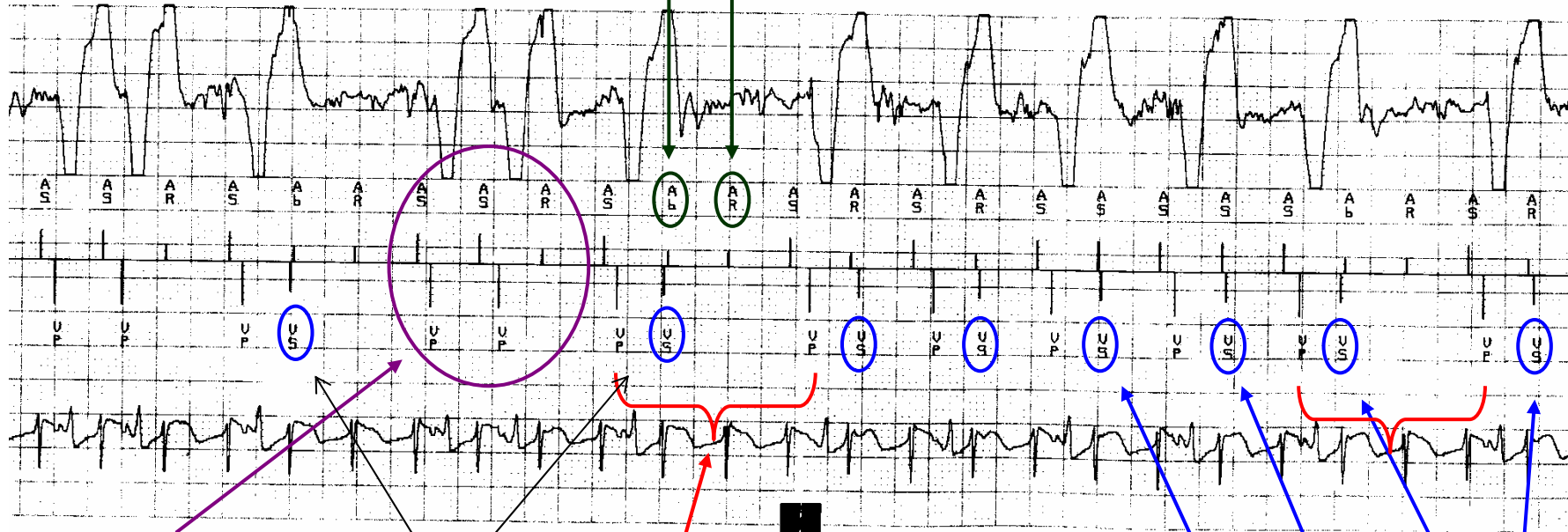# Moreover , we then saw the following :
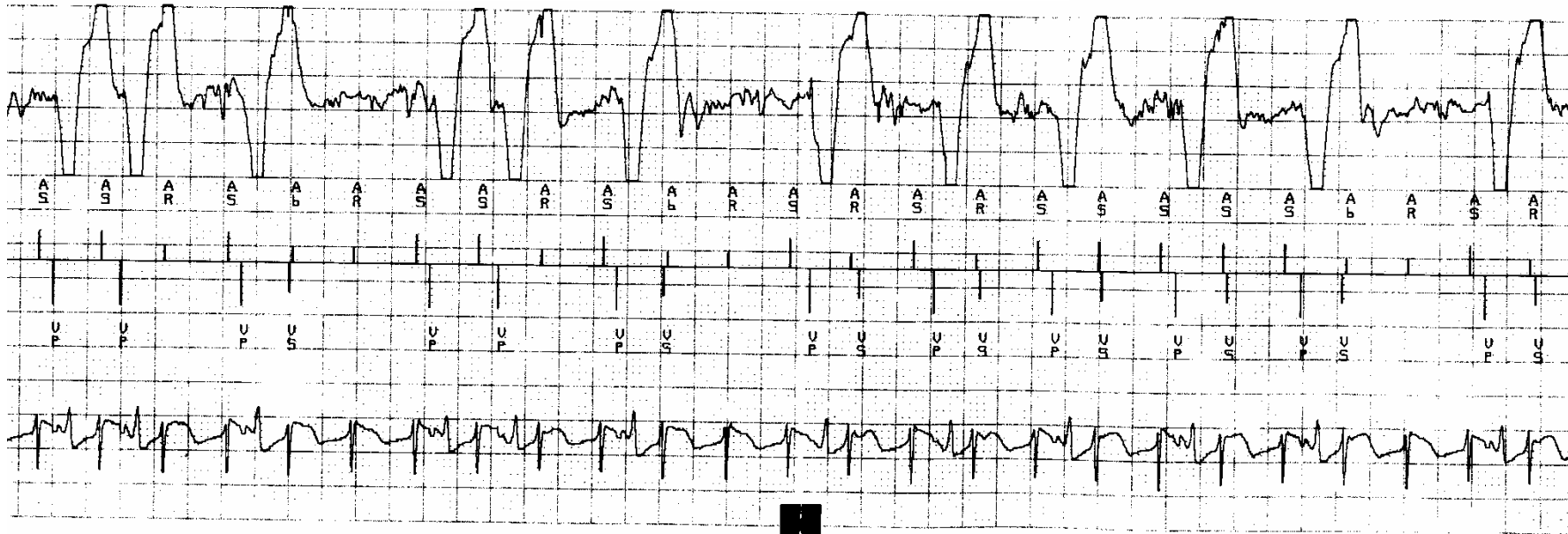
What is going on now ?

Interpretation

Intermittent T wave oversensing during exercise results in even longer intervals between paced beats in V because it extends the PVARP (TWOS is interpreted as VPCS which extends PVARP when PVC response is ON)

Sinus beats falling on PVAB and PVARP

Wenckebach

T wave oversensing

This results in long VV intervals

T wave oversensing

Summary of Findings

- This case demonstrates a combination of factors contributing to a state of inability to increase rate on exercise :
  - Inherent limitation of MTR in Enrhythm
  - Being an athlete he reaches his 2:1 rate (ACL<TARP)
  - FFRW sensing contributes to inappropriate AMS
  - T wave OS increases the pauses even further
- What programming changes are needed ?

New programming could help solve the Problem

Device: **EnRhythm P1501DR**
Serial Number: **PNP465977H**

Date of Visit: **01-Mar-**
9987 Software
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Final: Session Summary

Parameter Summary

Mode	DDD	Lower Rate	50 bpm	Paced AV	150 ms
Mode Switch	222 bpm	Upper Track	150 bpm	Sensed AV	120 ms
		Upper Sensor	150 bpm		

Detection		Rates	Therapies
AT/AF	Monitor	>222 bpm	All Rx Off
VT	Monitor	>176 bpm	

| Changes This Session	Session Start	Current Value
PVARP	270 ms	220 ms
V. Blank Post VP	200 ms	300 ms
RV Sensitivity	0.9 mV	2.1 mV
AT/AF Interval	350 ms (171 bpm)	270 ms (222 bpm)

Decreasing TARP can delay 2:1

Prevent TWOS

Prevents AMS episodes
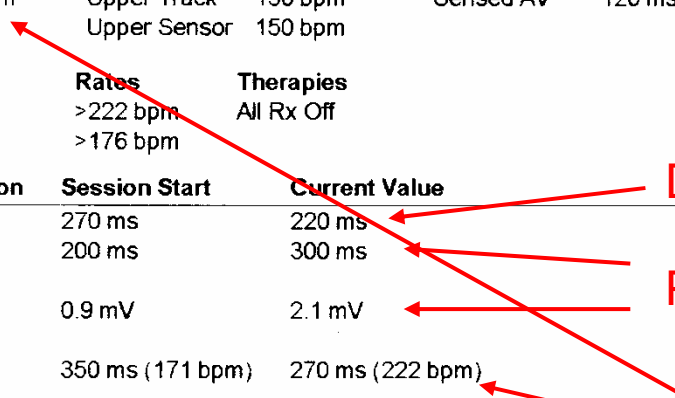
Addressing the far-field R wave by programming the PVAB appropriately

- When the PVAB method is programmed **Partial** (nominal) or **Partial+** atrial sensed events in the PVAB interval are ignored by bradycardia pacing features but are used by arrhythmia detection features.

- The difference is that in Partial+ the atrial sensitivity threshold is increased (less sensitive) following ventricular events to provide amplitude-based discrimination between far-field R-waves and intrinsic atrial events.

Atrial sensitivity following V event

Partial

Partial+
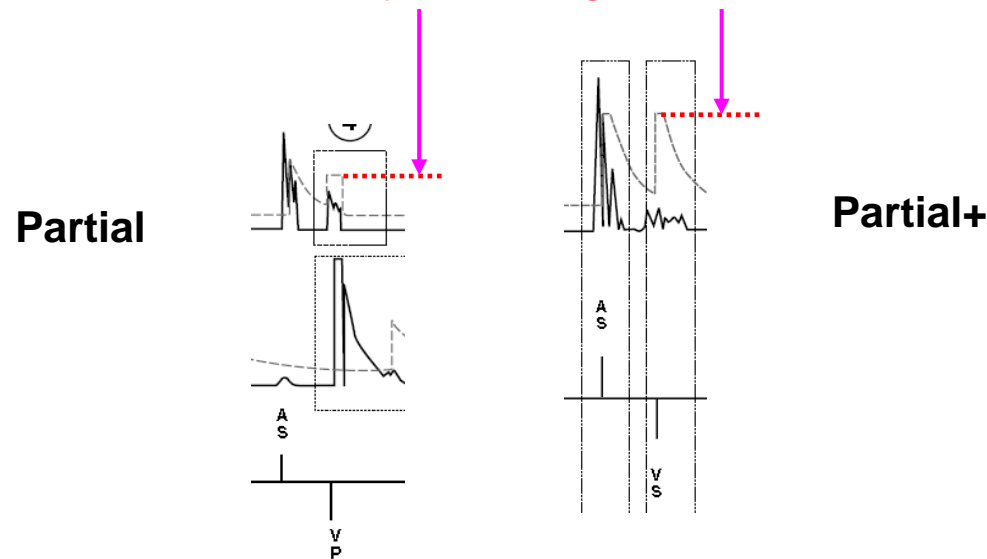
- If this doesn't solve the problem PVAB can be programmed **to Absolute**

- When the Absolute PVAB method is programmed, atrial sensed events in the PVAB interval are not used by either arrhythmia detection features or bradycardia pacing features.

Thank you!