

Cardiac Rhythm Device Management

'PBL STOP' – Your acronym for a standardized follow-up

What's in it for you?

- What do you need to feel comfortable with a pacemaker/ICD follow-up?



- Provide a technique for you to complete a successful device follow-up



“PBL STOP”

P Presenting Rhythm and Rate

B Battery Status

L Lead Status

S Sensing

T Threshold

O Observation, Data, and Events

P Program & Print

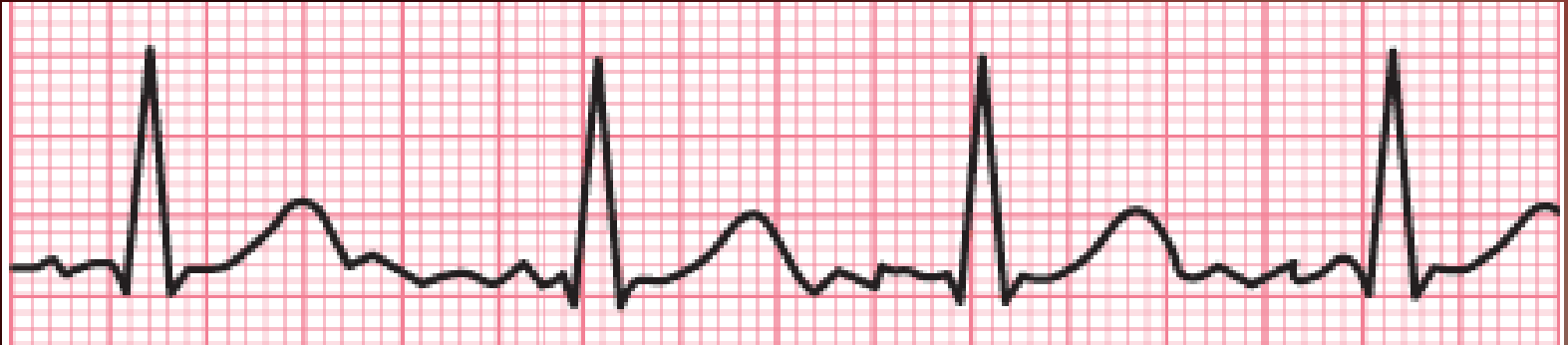


“P”

Presenting Rhythm and Rate

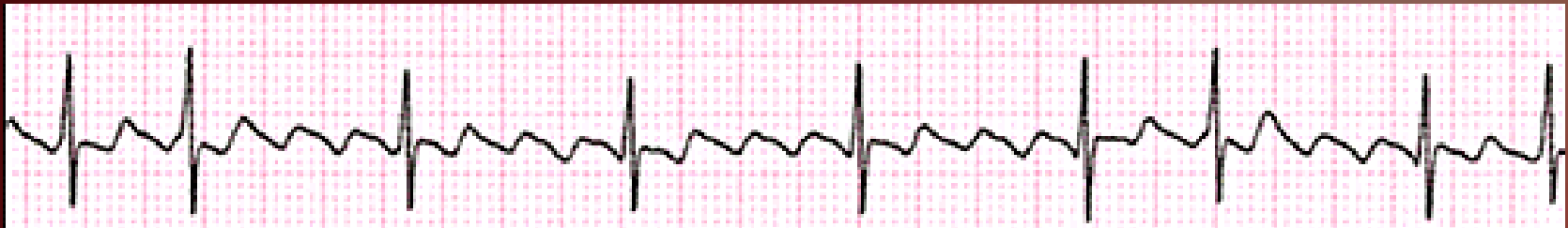


Rhythm Recognition



Atrial Fibrillation: No Pacing

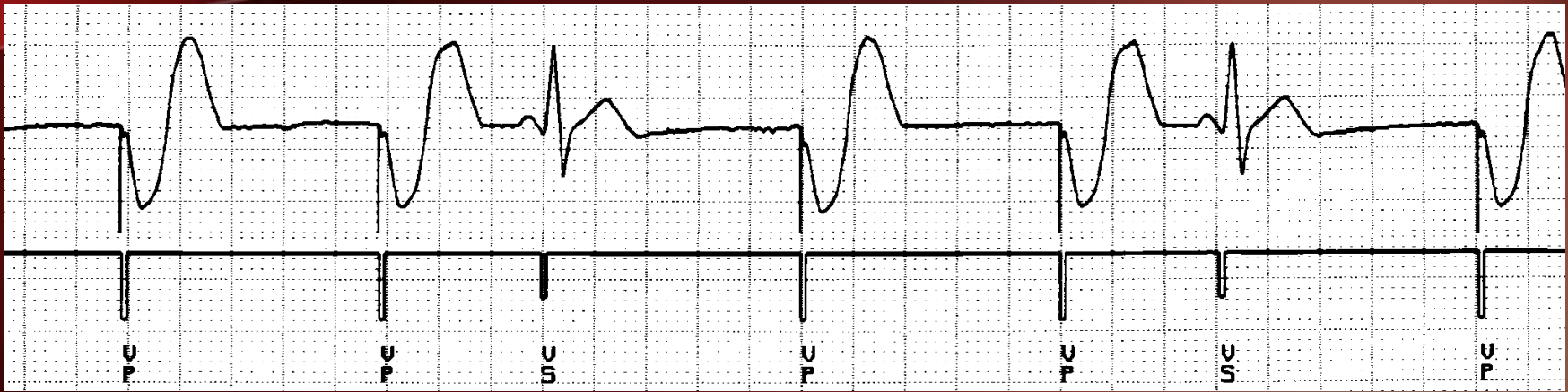
VVI / 60



Atrial Flutter: No Pacing

DDDR / 60

Paced Rhythm Recognition



Single Chamber Device: Ventricular Pacing



Single Chamber Device: Atrial Pacing (AAI)

Paced Rhythm Recognition



Sensing in the Atrium & Sensing in the Ventricle (AS-VS)



Pacing in the Atrium & Sensing in the Ventricle (AP-VS)

Paced Rhythm Recognition

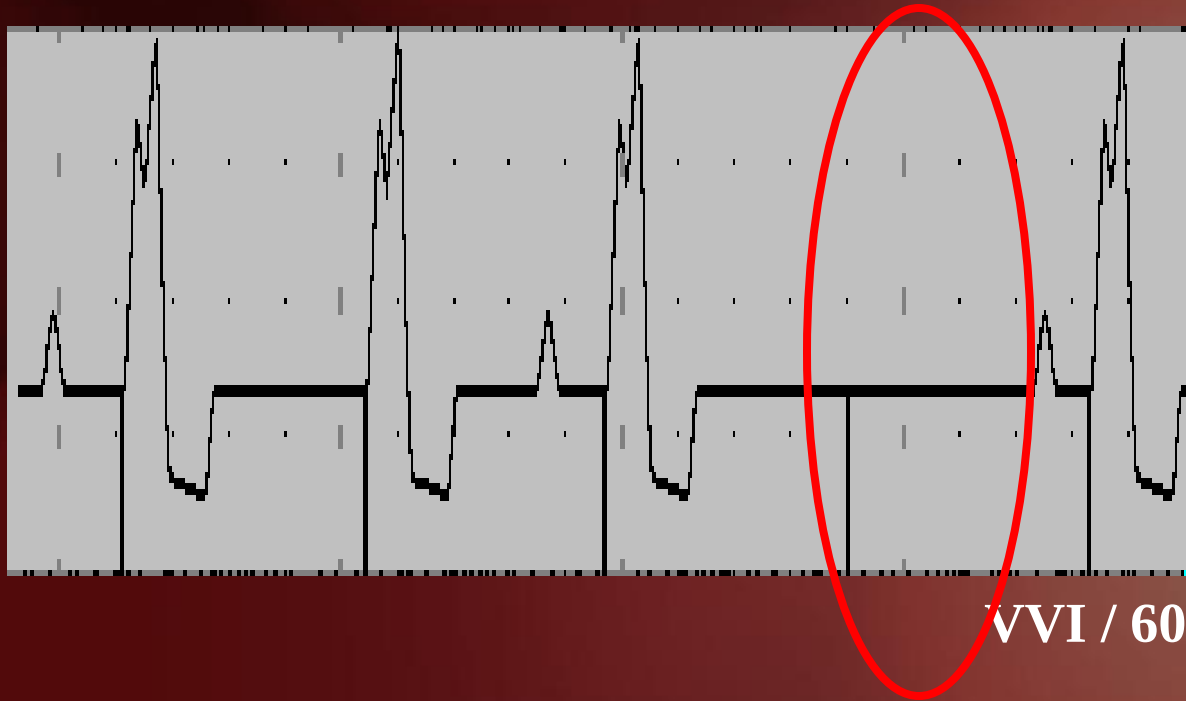


Sensing in the Atrium & Pacing in the Ventricle (AS-VP)



Pacing in the Atrium & Ventricle (AP-VP)

Troubleshooting



Loss of Capture



Loss of Atrial Sensing

“B”

Battery Status (Volts and Longevity)

Assessing Battery Status

Serial Number: PD0000400R File Saved: 23-Jan-2004 15:30:37

Read From Disk

Data Quick Look Clinical Status Since Last Session: 23-Jan-2004

Device Status (circled in red)

Battery Voltage 2.74 V (ERI=2.61 V)

Last Full Charge (Not Available)

Lead Atrial RV Observations (3)

P/R Wave (mV) 1.8 5.4

Pacing (ohms) 440 432

RV Defib (ohms) 43

SVC Defib (ohms) 100

Sensitivity (mV) 0.3 0.3

Amplitude (V) 3 3

Pulse Width (ms) 0.4 0.4

Emergency Open File... End Session

Clinical Status Since Last Session: 23-Jan-2004

Time	Treated	Monitored
AS-VS 71.7 %	VT/VF	
AS-VP 9.9 %		
AP-VS 13.8 %		
AP-VP 4.6 %		
MVP On	SVT	
AT/AF 0.3 %	AT/AF	

Observations (3):

- 3 shocks for VT/VF, 0 failed.
- At least 1 therapy failed in 1 VT/VF episodes.
- 1 treated VT/VF episodes longer than 30 sec.

DDDR DEMONSTRATION ONLY EnPulse E2DR01

60 bpm / 1,000 ms

Marker Annotation

Quick Look II 7-Dec-2005 Last Session: 30-May-2005

Remaining Longevity 7 - 10.5 years (circled in red)

Threshold (V@.4ms)

Impedance (ohms)

P Wave 0.7 to 2.8 mV

R Wave 16.0 to 22.4 mV

Emergency Interrogate... End Session...

Ready

Quick Look II - Initial Interrogation

Graphs and Tables

Battery and Lead Measurements

Data Collection Setup/Clear

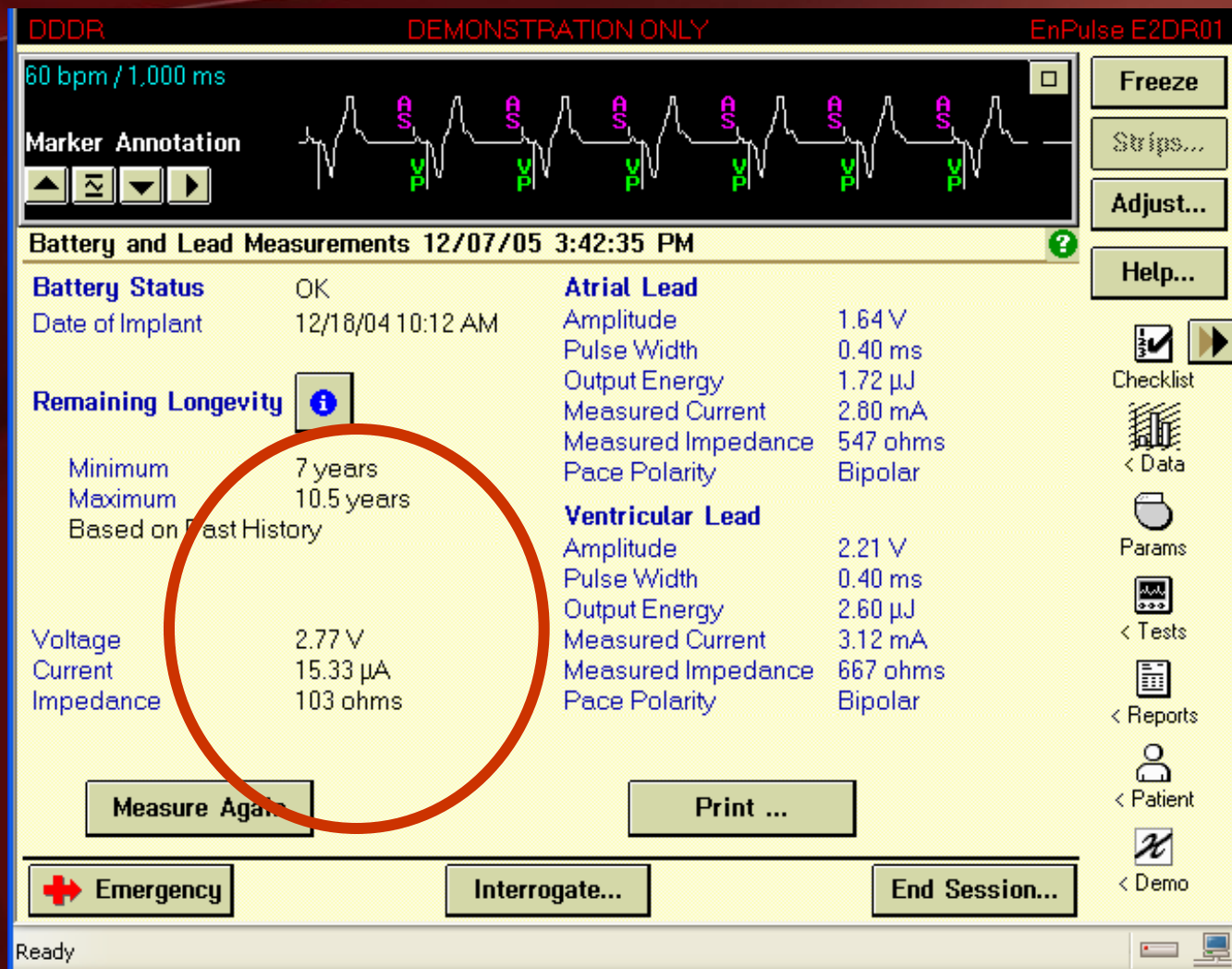
Observations

1 Vent. High Rate Episode

10 days with >4 hours AT/AF

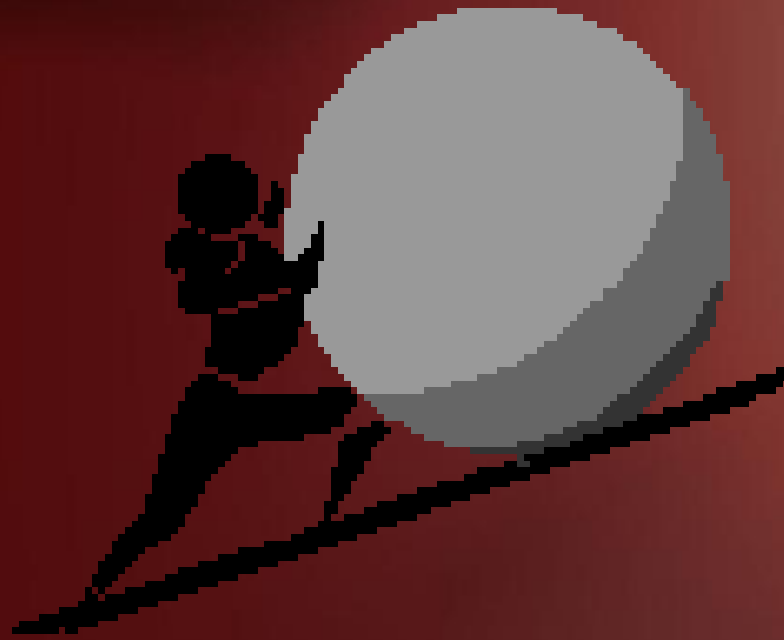
At times, VS rate >100 bpm during AT/AF

Assessing Battery Status

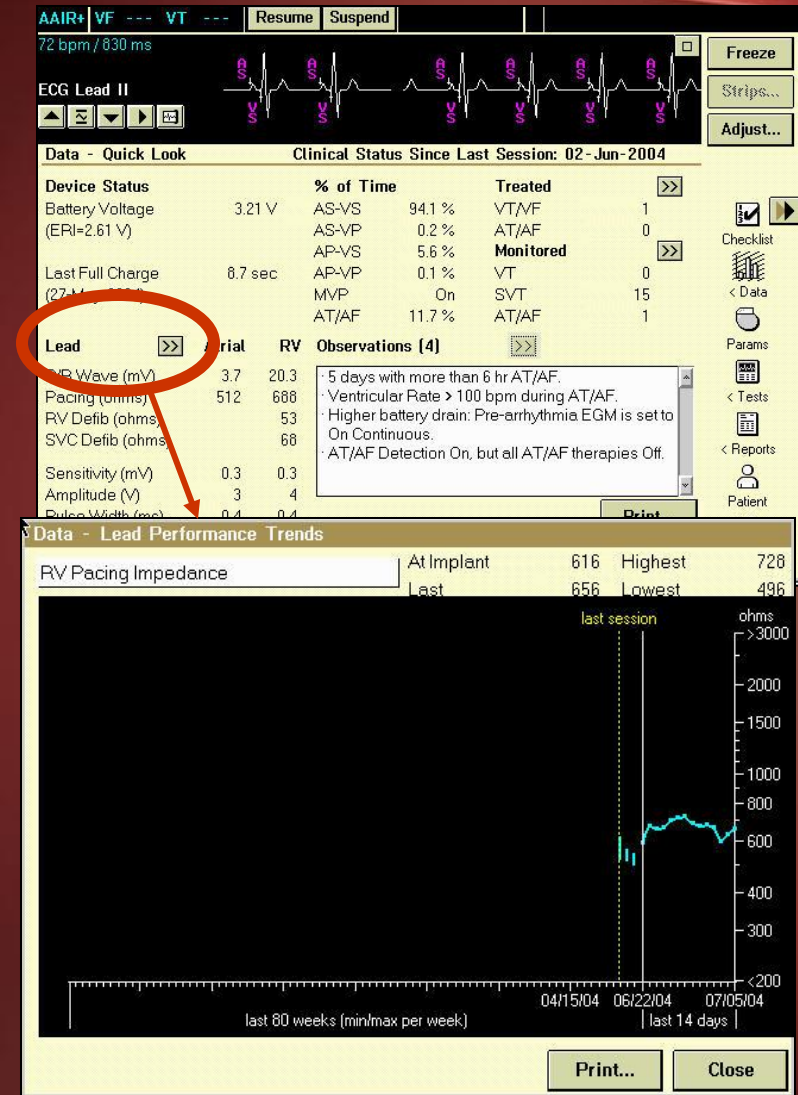
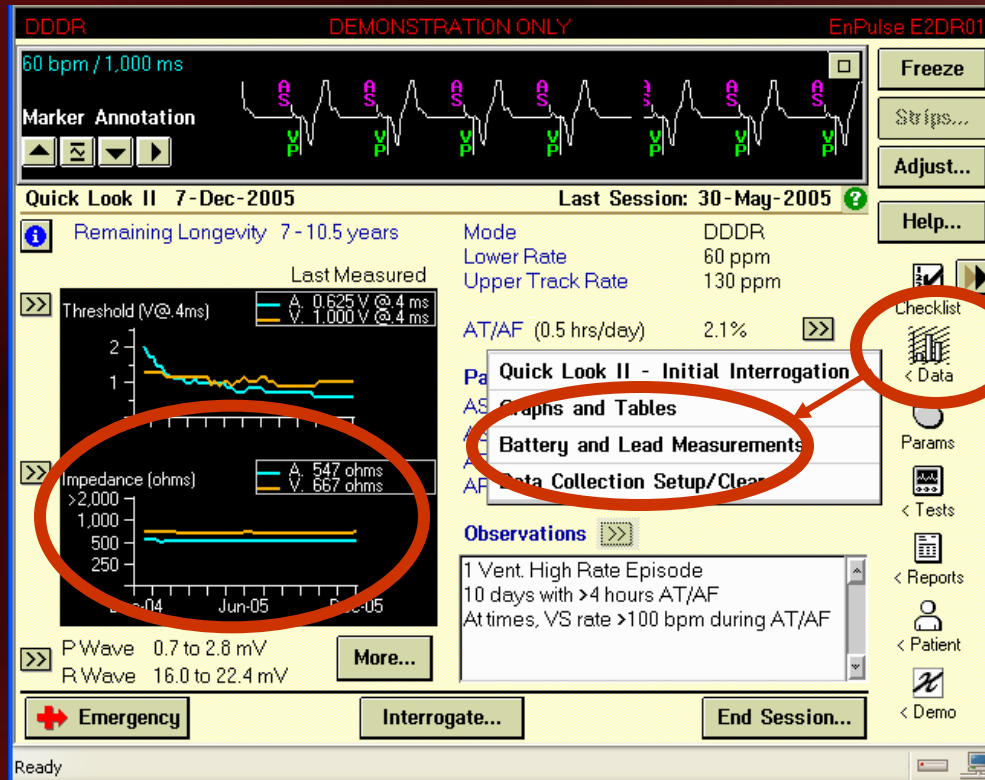


“1”

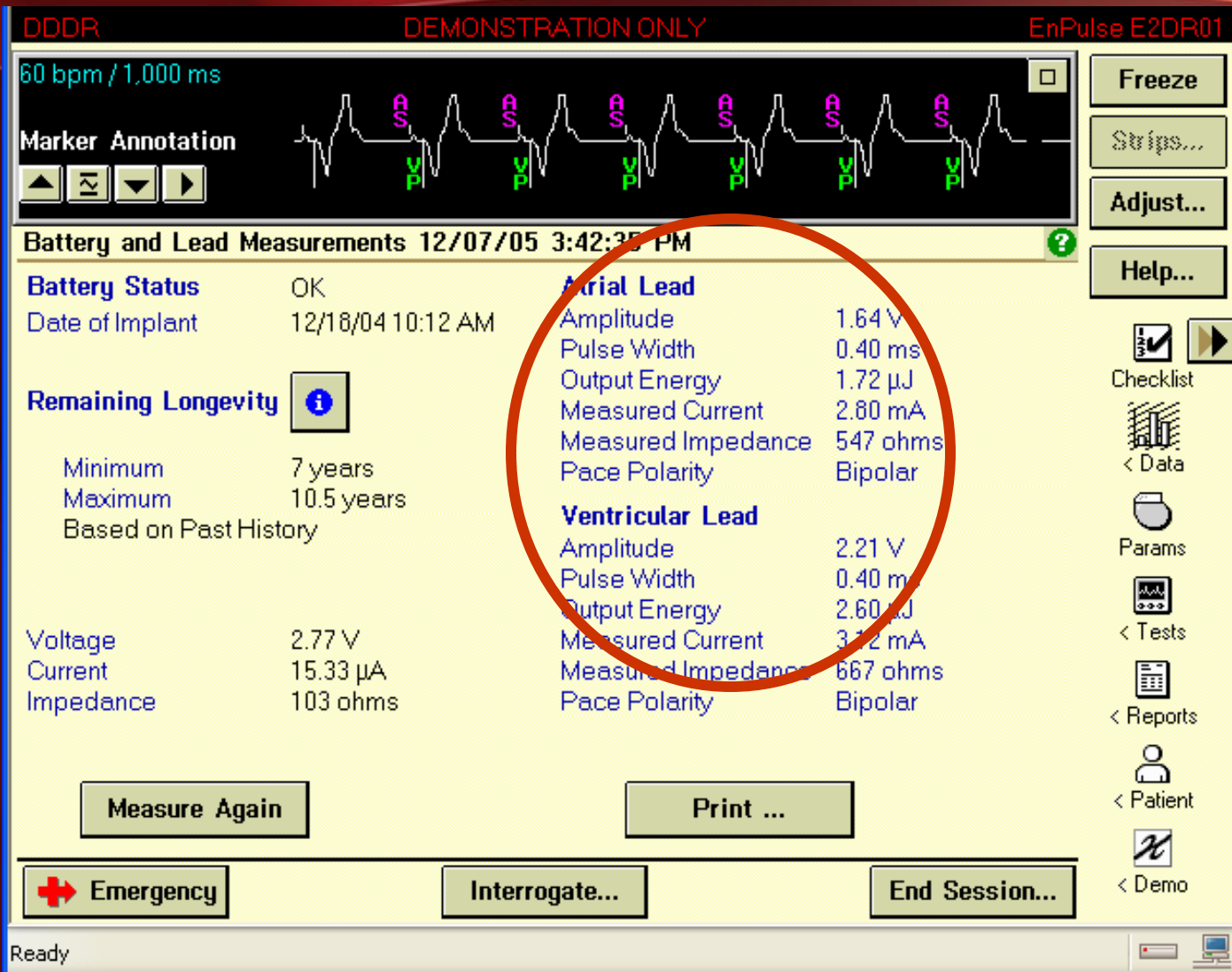
Lead Impedance (ohms)



Lead Impedance Trends



Assessing Lead Status



“S”



Sensing (millivolts mV)



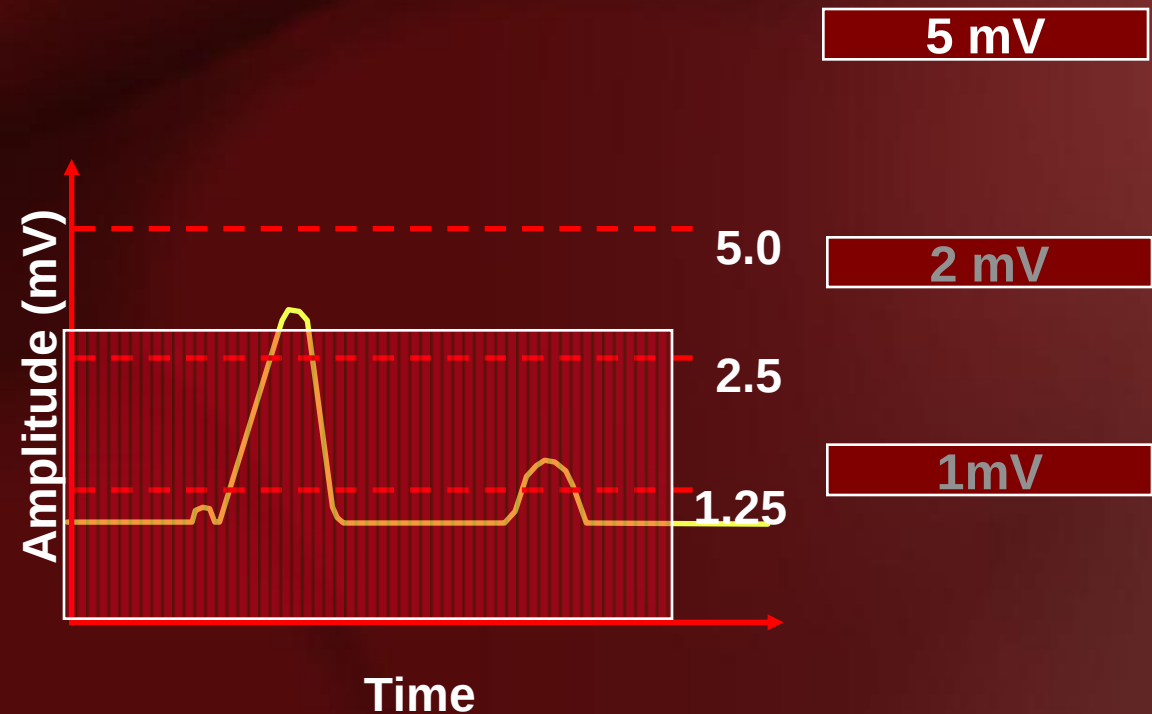
**The ability of the pacemaker to see
Intrinsic Heart Beats**

Normal Sensing Values

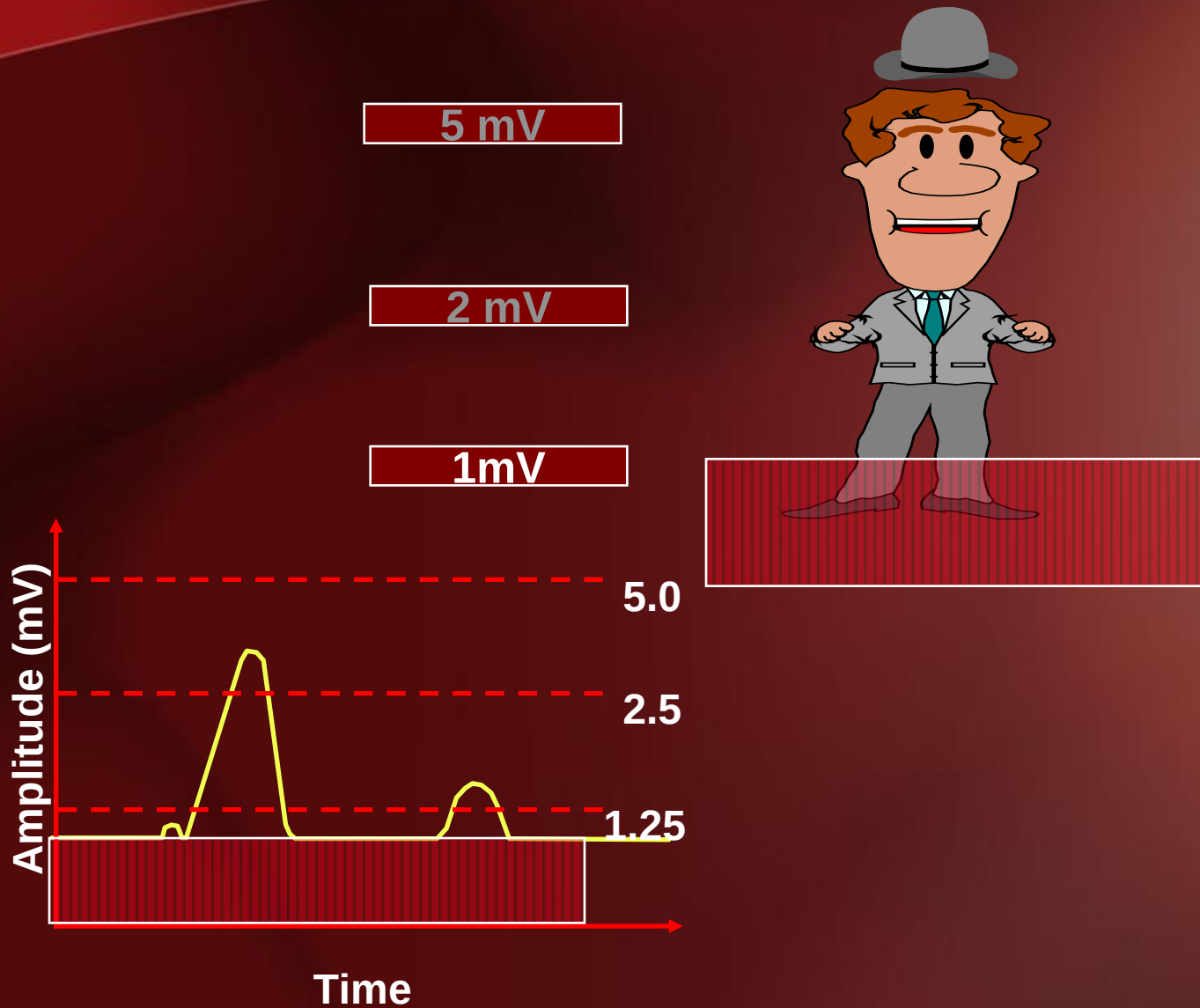
- **Acute Phase (within 3 months of implant)**
 - **P-waves = $> 1.5\text{mV}$**
 - **R-waves = $> 6\text{mV}$**
- **Chronic Phase (>3 months post-implant)**
 - **P-waves = $> 1.0\text{mV}$**
 - **R-waves = $> 5\text{mV}$**

Sensitivity: *Not Sensitive Enough*

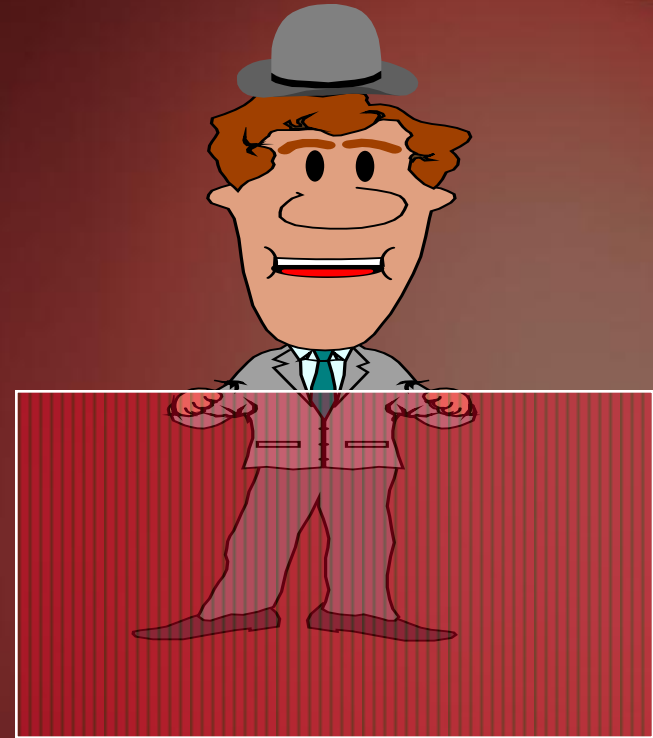
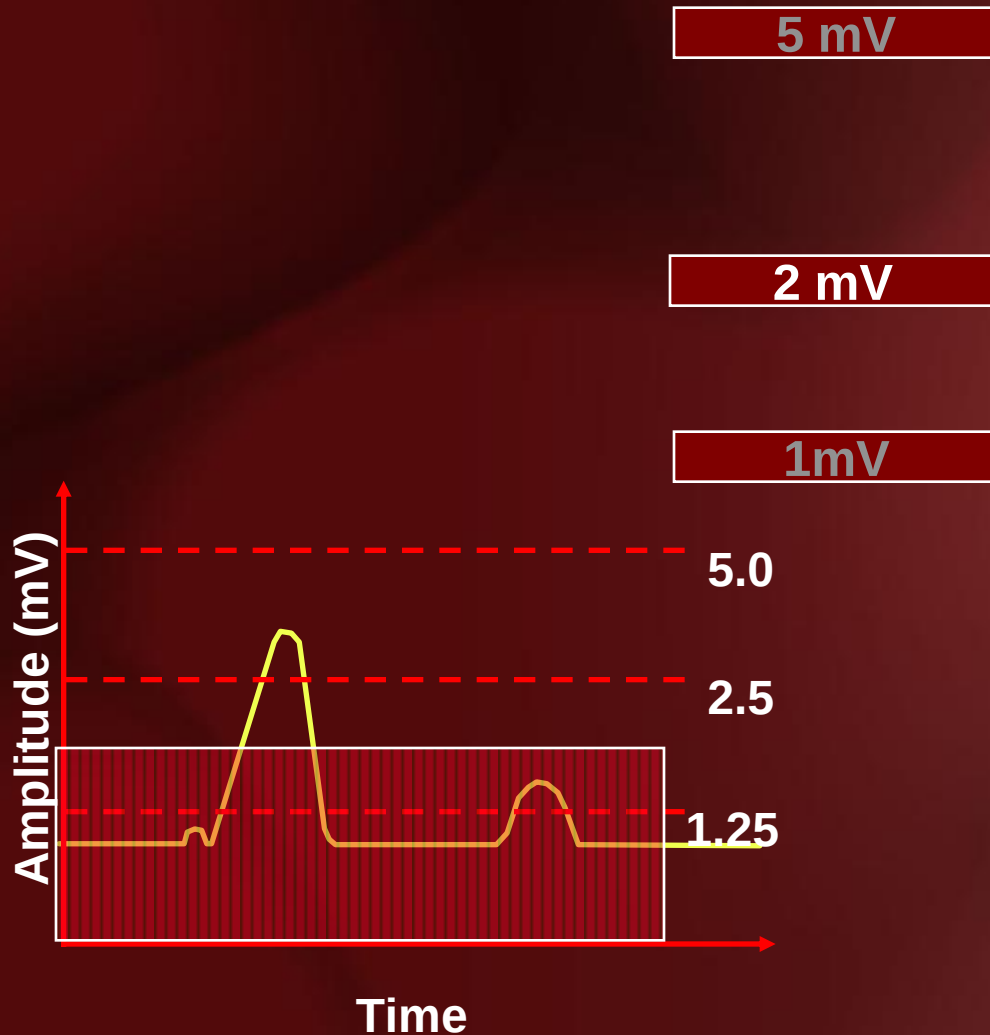
As You Lower The Number,
You Make The Pacemaker More Sensitive



Sensitivity: *Too Sensitive*

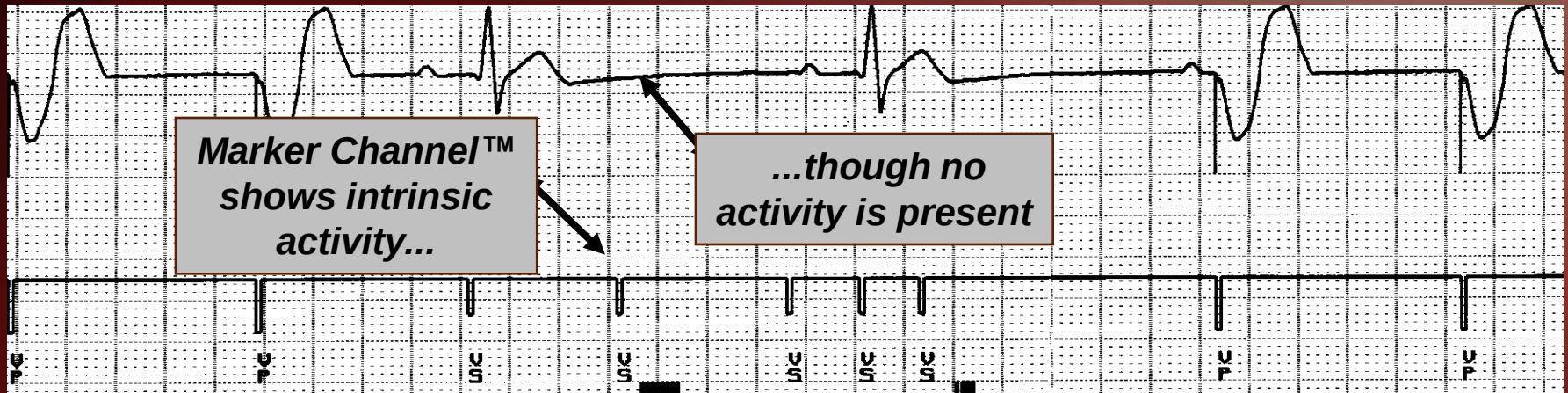
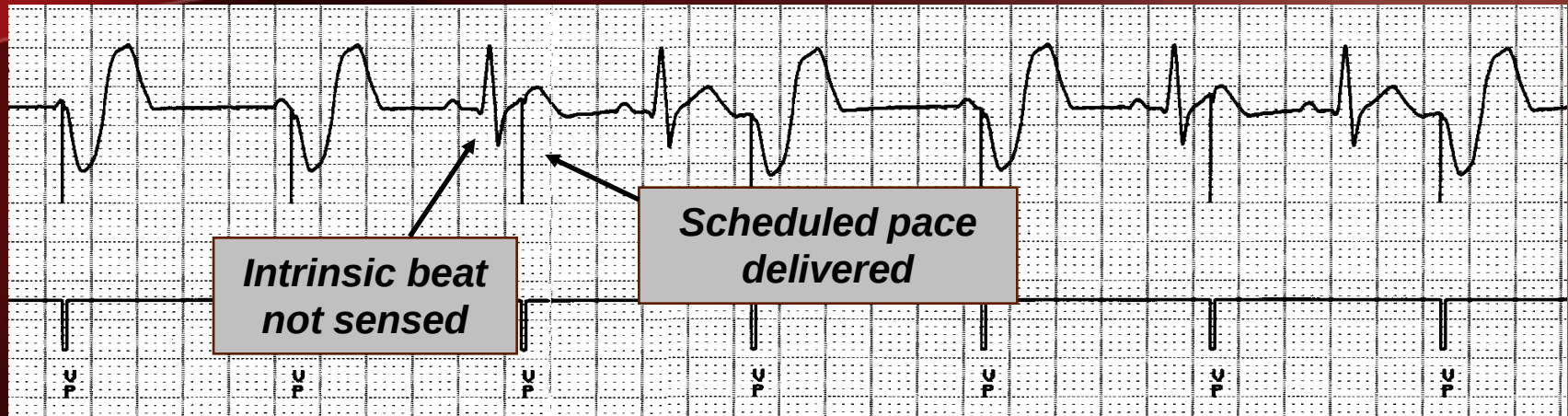


Sensitivity: *Just Right*



Why is sensing so important?

Oversensing vs. Undersensing



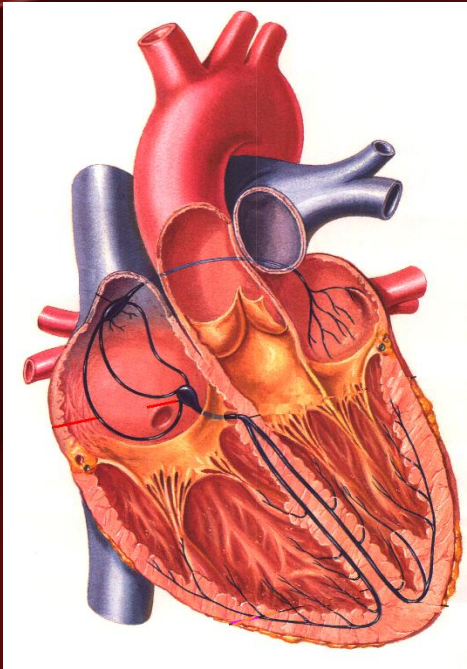


Threshold



The least amount of energy it takes
to “capture” the heart

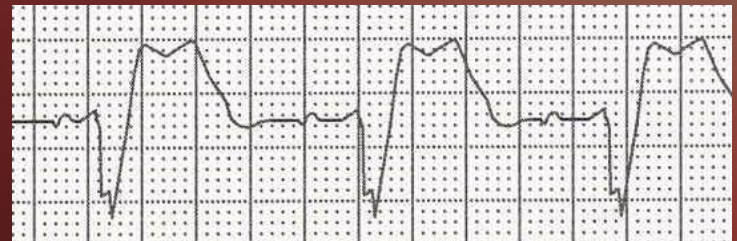
During Pacing, the Impulse:



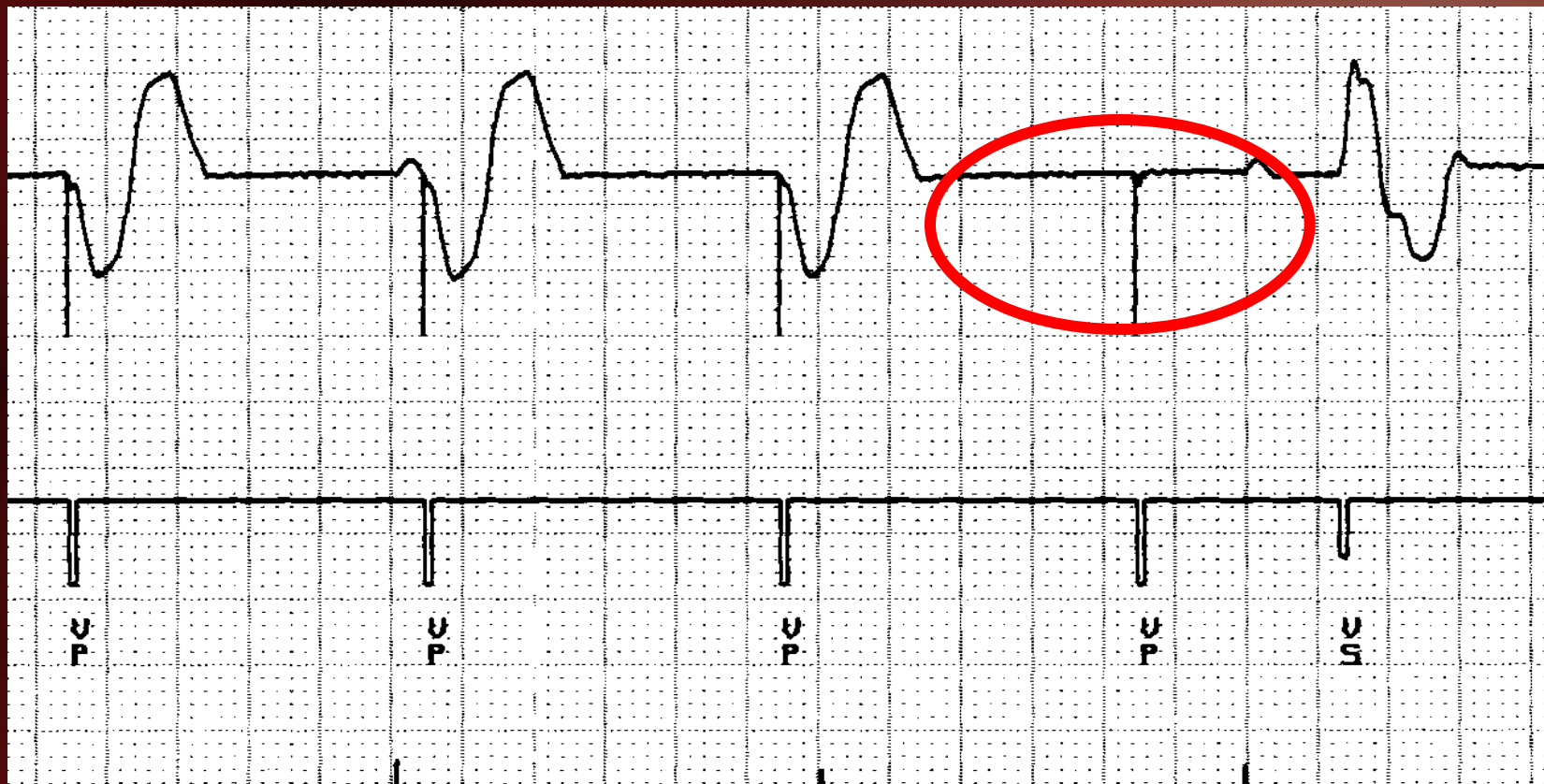
Travels via the myocardium, not the native cardiac conduction system, therefore, the QRS is wide



Normal QRS



Paced QRS



2 Settings Used to Ensure Capture

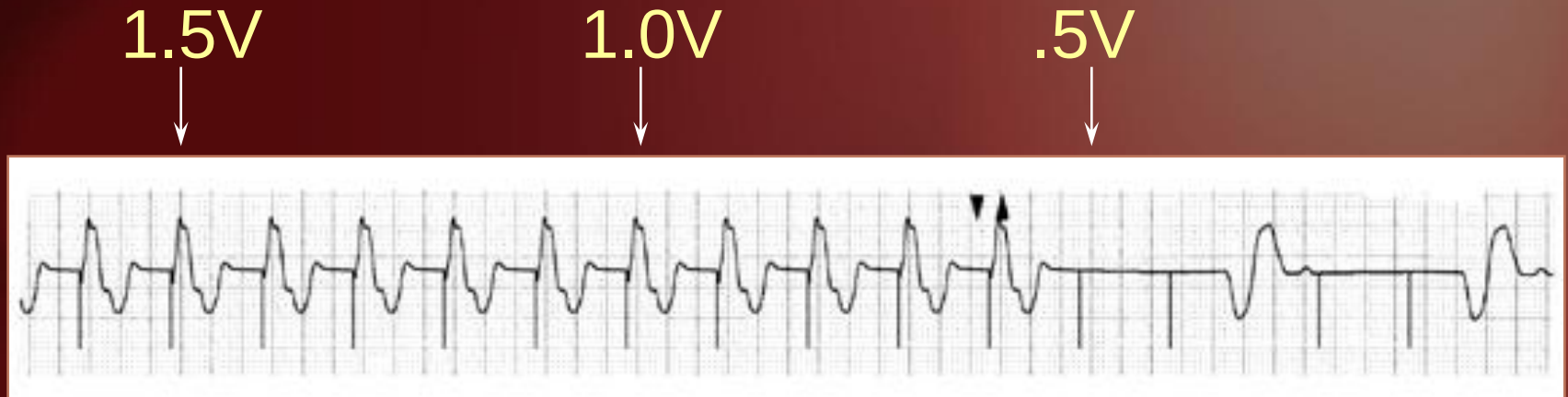
GOAL → Find the minimum amount of energy needed to *consistently* capture the heart (stimulation threshold).

1. **Pulse amplitude – the amount of voltage delivered to the heart by the pacemaker to ensure capture of the heart (strength of an output pulse)**
2. **Pulse width – time (duration) of the pacing pulse**

Amplitude Threshold Testing

Keeping pulse width stable, decrement voltage until loss of capture

@ 0.5ms

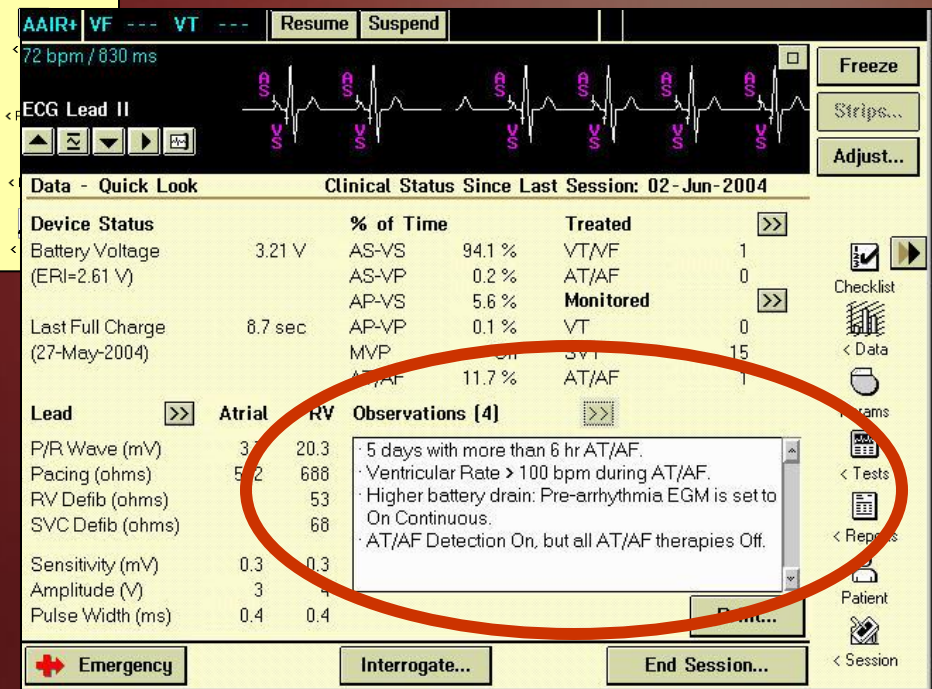
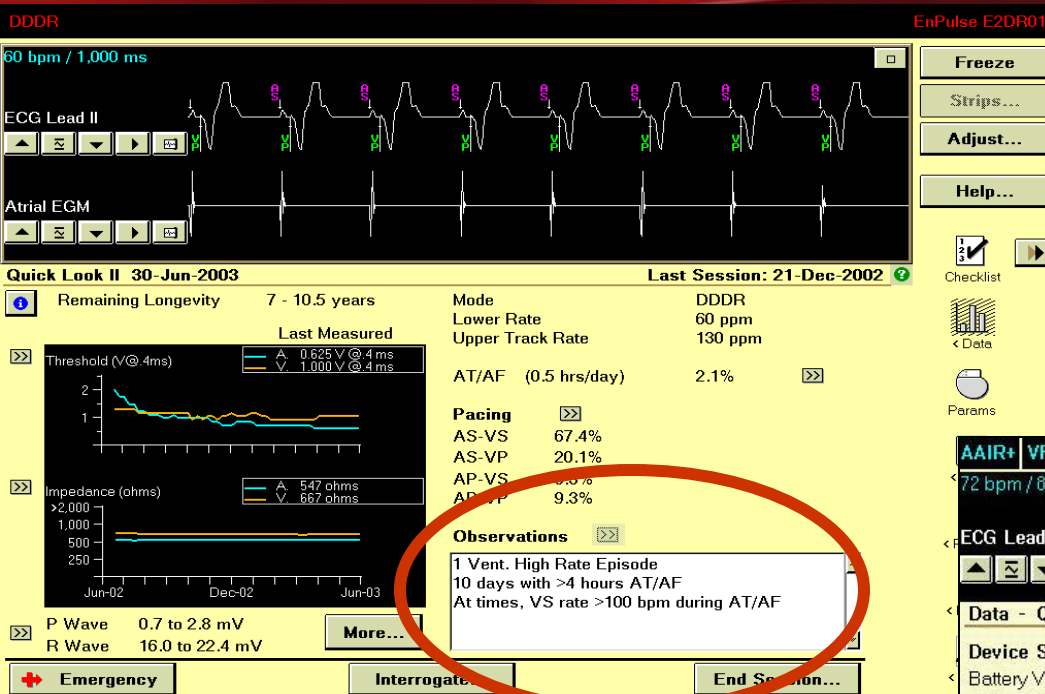




Observations, Data, and Events

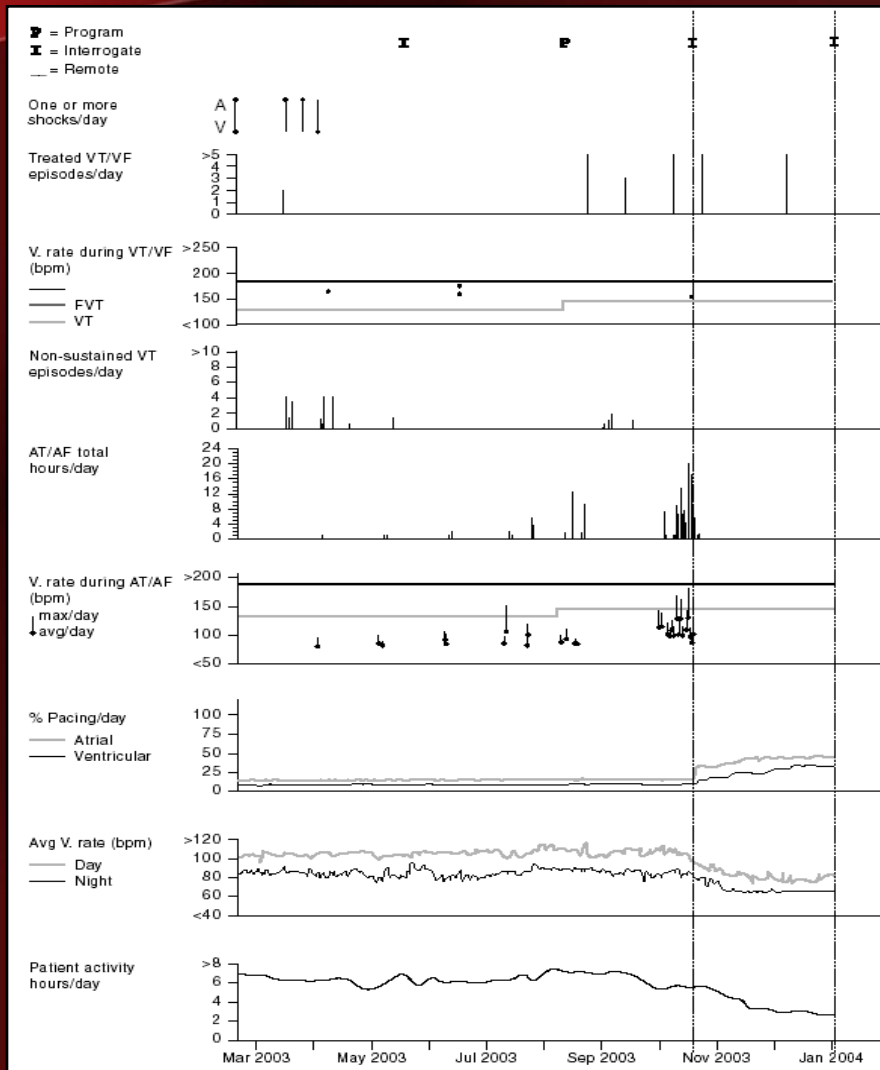


Diagnostic Information



Cardiac Compass®

- Up to 14 months of data
- Annotations to mark Programming (P), Interrogation (I) or Remote Interrogations (_)
- Rhythm-control assessment with *Treated VT/VF episodes per day* and *AT/AF total hours/day*
- Rate-control assessment with *V. Rate during AT/AF* and *V. Rate during VT/VF*
- %Pacing/day to assess reduction of unnecessary right ventricular pacing
- Three HF Status Indicator Trends
 - Average V. Day/Night heart rates
 - Patient Activity
 - HR variability



“P”



Programming & Printing Final Reports



Programmed Parameters

DDDR DEMONSTRATION ONLY EnPulse E2DR01

60 bpm / 1,000 ms

ECG Lead II

Parameters - Therapy

Modes/Rates		Atrial Lead		Ventricular Lead	
Mode	DDDR	Amplitude	1.500 V	Amplitude	2.000 V
Mode Switch...	175 bpm	Pulse Width	0.40 ms	Pulse Width	0.40 ms
Lower Rate	60 ppm	Sensitivity...	0.50 mV	Sensitivity...	5.60 mV
Upper Track	130 ppm	Pace Polarity...	Bipolar	Pace Polarity...	Bipolar
Upper Sensor	130 ppm	Sense Polarity...	Bipolar	Sense Polarity...	Bipolar
Rate Response...	☒	Capture...	Adaptive	Capture...	Adaptive

Intrinsic/AV Refractory/Blanking Additional/Interventions

Intrinsic Activation...	PVARP...	Auto	Additional Features...
Paced AV... 150 ms	PVAB	180 ms	Interventions...
Sensed AV... 120 ms			

Save... Get... Undo Pending Print... PROGRAM

Emergency Interrogate... End Session...

Ready

AAI+ VF FVT VT AT/AF Resume Suspend

65 bpm / 920 ms

ECG Lead II

ECGM1: Atip/Aring

Parameters

Mode	AAI<=>DDD	Lower Rate	60 bpm	A. Sensitivity	0.3 mV
Mode Switch	On	Upper Track	130 bpm	RV Sensitivity	0.3 mV
Pacing...		Upper Sensor	130 bpm		

Detection	Interval (Rate)	Initial	Therapies...
VF	On 320 ms (188 bpm)	18/24	ATP During Charging, 30J x 6
FVT	via VF 240 ms (250 bpm)		30J x 6
VT	On 400 ms (150 bpm)	16	Burst(3), 20J, 30J x 4
Detection (V.)...	AF/Afl, Sinus Tach, VT Monitor		

AT/AF On 350 ms (171 bpm) 1 Zones... Burst+, Ramp, CV Off

Data Collection Setup... Patient Alert... 1 On

Save... Get... Undo Pending Print... PROGRAM

Emergency Interrogate... End Session...

Print Reports

- Print Final Reports
 - Sensing test results
 - Threshold test results
 - Key observations
 - Any changes this session noted on final report

“PBL STOP”

- P** Presenting Rhythm and Rate
- B** Battery Status
- L** Lead Status
- S** Sensing
- T** Threshold
- O** Observation, Data, and Events
- P** Program & Print