Trouble in Paradise: Difficult CIED Troubleshooting

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97 yo – 1 week s/p DC PM Implant

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Modes

Mode	DDDR
Mode Switch	On
Detection Rate	150 bpm
Detection Duration	No Delay
Blanked Flutter Search	On

Rates

Lower Rate	90 ppm
Upper Tracking Rate	120 ppm
Upper Sensor Rate	120 ppm
ADL Rate	95 ppm

Intrinsic/AV

Paced AV	180 ms
Sensed AV	120 ms
Search AV+	Off
Sinus Preference	On
Sinus Preference Zone	10 ppm
Search interval	10 min
Rate Adaptive AV	On

Intrinsic/AV

Start Rate	90 ppm
Stop Rate	120 ppm
Maximum Offset	-40 ms

Refractory/Blanking

PVARP	Auto
Minimum PVARP	250 ms
PVAB	180 ms
Ventricular Refractory	230 ms
Vent. Blanking (after A. Pace)	28 ms
PMT Intervention	On
PVC Response	On
Ventricular Safety Pacing	On

Rate Response

Optimization	On
ADL Response	3
Exertion Response	3
ADLR Percent	2.0%
Activity Threshold	Medium/Low

Rate Response

Activity Acceleration	30 sec
Activity.Deceleration	Exercise
High Rate Percent	0.2%
ADL Rate Setpoint	13
Upper Sensor Rate Setpoint	35

Atrial Lead

Amplitude	3.500 V
Pulse Width	0.40 ms
Sensitivity	0.18 mV
Sensing Assurance	On
Pace Polarity	Bipolar
Sense Polarity	Bipolar
Lead Monitor	Monitor Only
Maximum Impedance	4.000 ohms
Minimum Impedance	200 ohms
Monitor Sensitivity	8
Capture Management	Off

Ventricular Lead

Amplitude	3.500
Pulse Width	0.46 r
Sensitivity	5.60 r
Sensing Assurance	On
Pace Polarity	Bipola
Sense Polarity	Bipola
Lead Monitor	Adapt
Maximum Impedance	4.000
Minimum Impedance	200 o
Monitor Sensitivity	8
Capture Management	Adapt
Amplitude Margin	2x
Min. Adapted Amplitude	2.000
Capture Test Frequency	Day a
Acute Phase	105 d
V. Sensing During Search	Adapt

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Battery Status

Estimated remaining longevity:	7.5 years, 6 - 9 years
Based on Past History	
Voltage/Impedance	2.79 V / 100 ohms

Parameter Summary

Mode	DDDR	Lower Rate	90 ppm	Search AV+	C
Mode Switch	On	Upper Tracking Rate	120 ppm	Paced AV	1
Detection Rate	150 bpm	Upper Sensor Rate	120 ppm	Sensed AV	1

Lead Summary

	Atrial	Ventricular
Measured Threshold	Off	0.500 V at 0.40 ms
Date Measured		02/07/18
Programmed Output	3.500 V / 0.40 ms	3.500 V / 0.46 ms
Capture	Off	Adaptive
Measured P / R Wave	<0.7 to 1.4 mV	>=80% Paced
Programmed Sensitivity	0.18 mV	5.60 mV
Measured impedance	457 ohms	575 ohms
Lead Status	OK	OK
Lead Model	407652	407658
Implanted	1-30-18	1/30/18

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What is your generic diagnosis?
1. Oversensing
2. Undersensing
3. Failure to capture
4. Crosstalk

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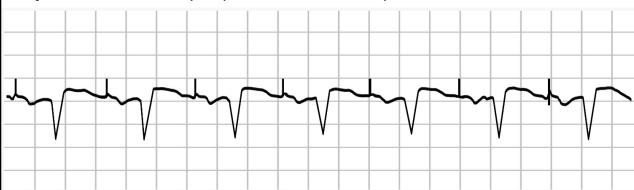What of the following would "NOT" be in your differential based on the clinical scenario and the generic diagnosis?

1. Lead dislodgement
2. Lead fracture
3. Loose set screw
4. Air in the header

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Pacemaker programmed to DDI 86 ppm; AVI = 165 ms; PVAB = 13 ms. Referred with ? of abnormal PM function
(Note – all A activity is paced & all V activity is intrinsic
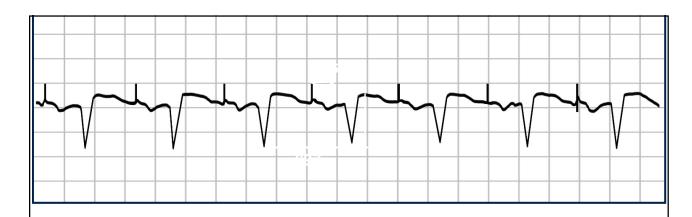
The most appropriate approach would be:
1. Lengthen PVARP
2. Lengthen PVAB
3. Lengthen AVI
4. Lower the upper rate limit

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Determining the VA Interval
VV = AV + VA
VV - AV = VA
Programmed VV = 86 ppm = 697 ms
AV = 165 ms
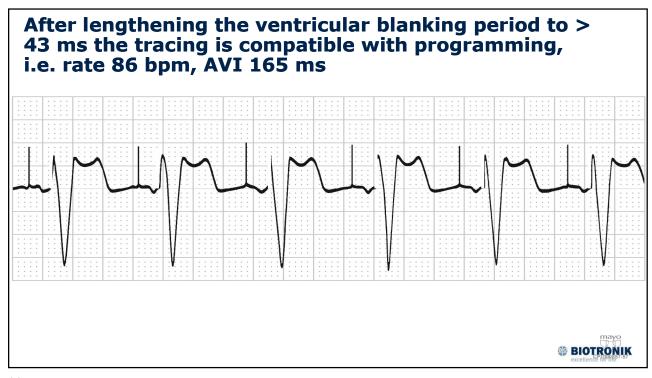**697 - 165 = 532 ms (VA)**
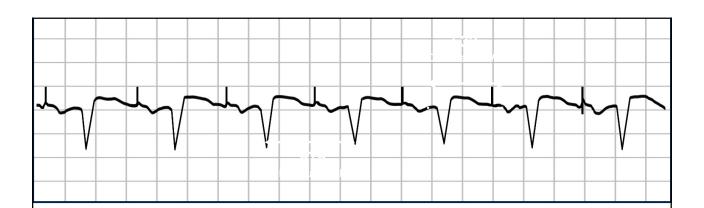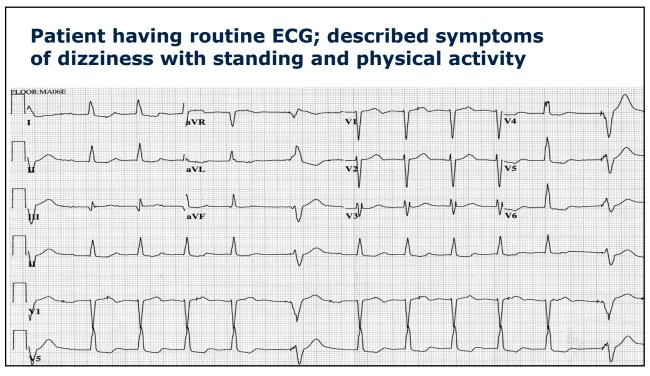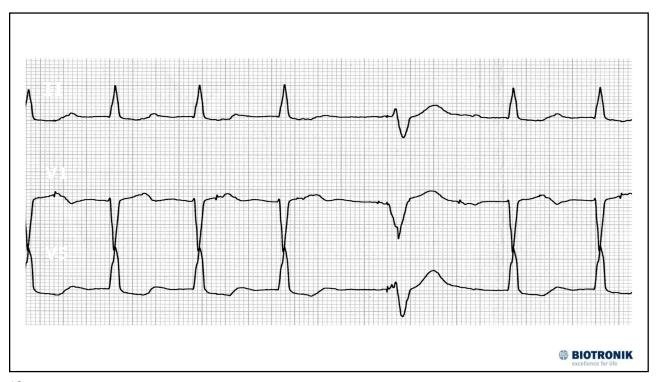
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Measured RR = 575 ms = VV
575 - 532 (VA) = 43 ms (AV)
Point of sensing after atrial output is 43 ms
Blanking period of > 43 ms should avoid crosstalk

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After lengthening the ventricular blanking period to > 43 ms the tracing is compatible with programming, i.e. rate 86 bpm, AVI 165 ms

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Patient having routine ECG; described symptoms of dizziness with standing and physical activity

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Brady Programming:

- Pacing Mode: DDDR ↔ AAIR
- Lower Pacing Rate: 60 ppm
- Upper Rate: 110 ppm
- Blanking after pace: 200 msec
- Paced AV Delay: 340 msec
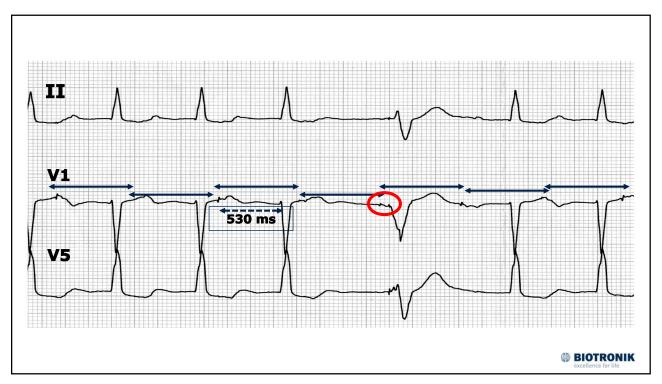- Sensed AV Delay: 310 msec
- PVARP: 250 msec

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Symptoms are related to:

1. Ventricular undersensing
2. Atrial failure to capture
3. Effective AV dissociation
4. Non-pacemaker issues

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530 ms

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Symptoms are related to:

1. Ventricular undersensing – *Any suggestion of undersensing is a function of the MVP algorithm and one would need to overlay refractory and blanking periods – would be available with interrogation*
2. Atrial failure to capture – *Telemetry strips should be used to definitively demonstrate that atrial capture normal; also programming to AAI or DDI and performing atrial capture thresholds should be part of troubleshooting*
3. Effective AV dissociation – *As a result of MVP*
4. Non-pacemaker issues – *Non-answer + there is a pacemaker explanation*
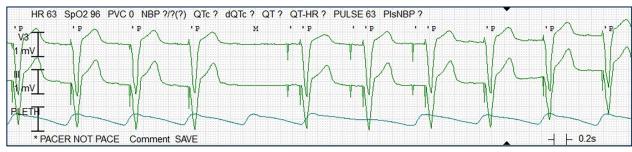
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Pacemaker syndrome 2° to MVP

- The patient was having dizziness with standing and with physical activity. ECG demonstrates pacing spikes before and on the T wave.
- AV delay was being extended so much by the MVP mode (>400 ms), the patient would develop a 2:1 heart block at low rates and effective V rate would drop.
- Reprogrammed to DDDR and extended P-AV delay to 340 msec. Sitting the patient was Ap-Vs; standing heart rate ↑ into the 70's with AV pacing ; no dizziness with standing.
- The patient will return in one month to recheck the device and see if has improvement and check AV pacing percentages.

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Rhythm strip obtained the afternoon after the pacemaker implant. Patient asymptomatic. RNs call pacemaker service….Generic diagnosis?

HR 63 SpO2 96 PVC 0 NBP ?/?(?) QTc ? dQTc ? QT ? QT-HR ? PULSE 63 PlsNBP ?

* PACER NOT PACE   Comment SAVE   0.2s

1. Failure to capture
2. Failure to output
3. Undersensing
4. Rate variation

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Pacing Summary

Mode		Rates		AV Intervals	
Mode	DDD	Lower	50 bpm	Paced AV	150 ms
Mode Switch	222 bpm	Upper Track	210 bpm	Sensed AV	110 ms
		Upper Sensor	145 bpm		

Pacing Details	Atrial	RV
Amplitude	2.00 V	5.00 V
Pulse Width	0.40 ms	0.50 ms
Capture Management	Adaptive	Adaptive
Amplitude Margin	2.0 X	2.0 X
Min. Adapted Amplitude	2.00 V	2.50 V
Acute Phase Remaining	119 days	119 days
Sensitivity	0.30 mV	0.45 mV
Pace Polarity	Bipolar	Bipolar
Sense Polarity	Bipolar	Bipolar
Lead Monitor	Adaptive	Adaptive
Min Limit	200 ohms	200 ohms
Max Limit	3000 ohms	3000 ohms

Date of Visit: **05-Nov-2014 09:25:40**

Device: **Advisa DR MRI A2DR01**
Serial Number:

9995 Software Version 8.3
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MFMER
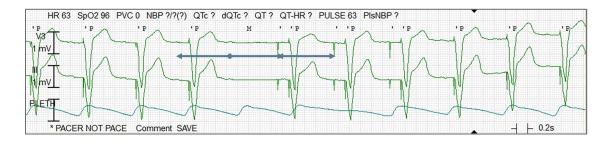slide-20 **BIOTRONIK** excellence for life

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Failure to Output

- Oversensing
  - Crosstalk
  - EMI
- Battery failure
- Circuit failure
- Lead fracture
- Internal insulation failure

- Loose set-screw
- Incompatible lead/header
- Pseudomalfunction/ Device nuance

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If intervals are regular and baseline steady, less likely to be oversensing .

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Failure to Output

- ~~Oversensing~~
  - ~~Crosstalk~~
  - ~~EMI~~
- ~~Battery failure~~
- ~~Circuit failure~~
- ~~Lead fracture~~
- ~~Internal insulation failure~~

- ~~Loose set-screw~~
- ~~Incompatible lead/header~~
- Pseudomalfunction
- Device nuance - peculiarity

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Engineering explanation:

- An occasional 'dropped VP' is specific to DDDR and DDD modes during atrial tracking (AS–VP) and may occur intermittently on an hour and 30 s schedule.
- A false ventricular sense may occur due to residual electrical disturbance on the ventricular sense amplifier and may be created by turning on/off the diagnostic EGM amplifiers during reference EGM collection. The scheduled reference EGM collection is synchronized to sensing and pacing events so that the device's sense amplifiers are blanked. However, there is no ventricular blanking following an AS event, which makes this phenomenon possible. The collection of reference EGM is non-programmable and is always active in the device.

Mehra, et al. Europace e-Pub April 16, 2015

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