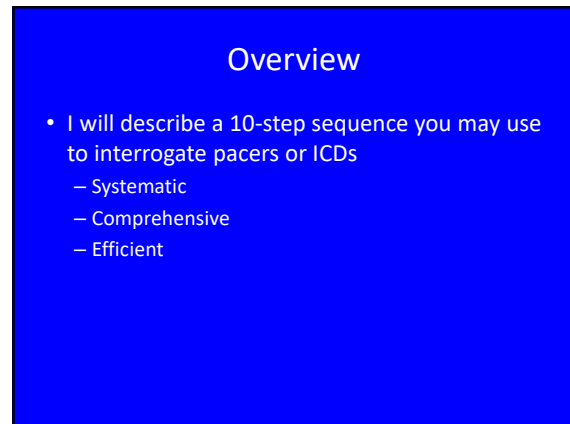
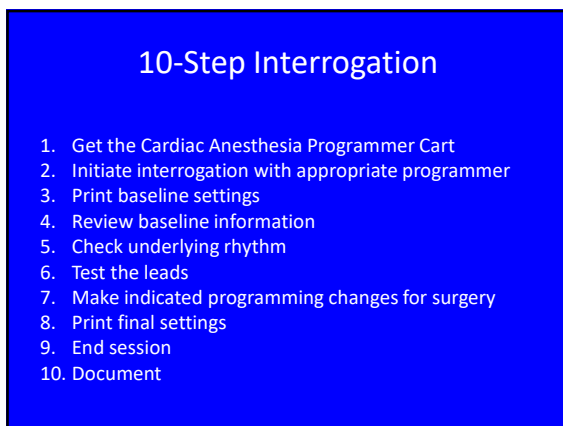


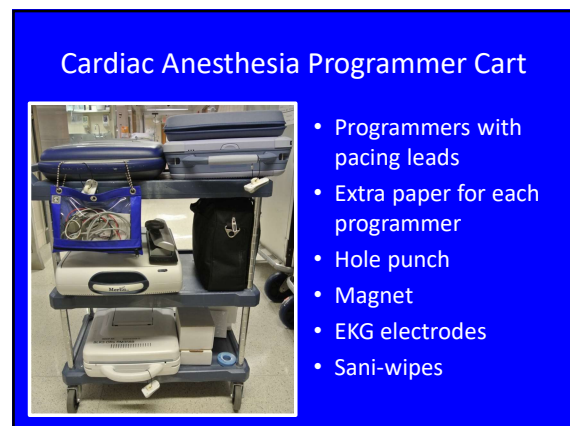
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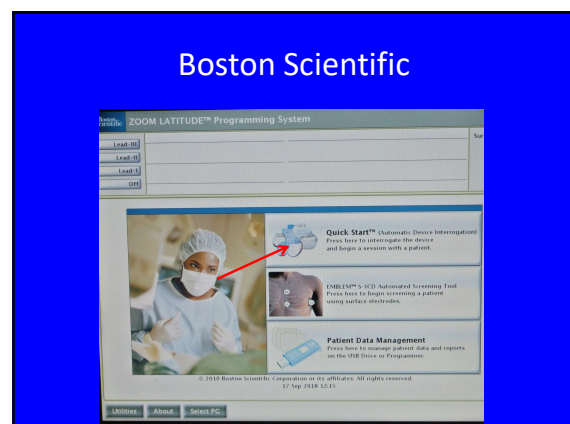
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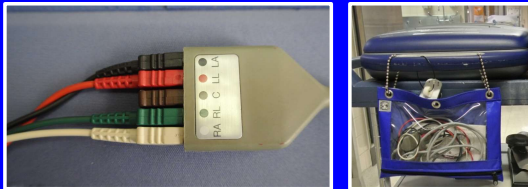
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9

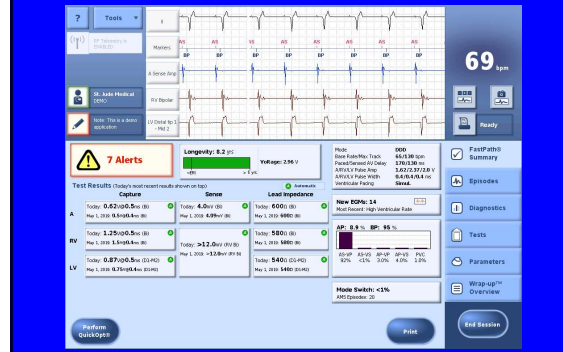
Attach the Programmer's EKG leads

While the programmer session is starting, it is wise to attach the programmer EKG leads to the patient



10

St Jude Initial Screen



11

10-Step Interrogation Sequence

3. Print Baseline Settings

– It is very easy to get distracted by a complicated interrogation/situation. Get in the habit of printing the baseline parameters before you start analyzing the settings and leads

12

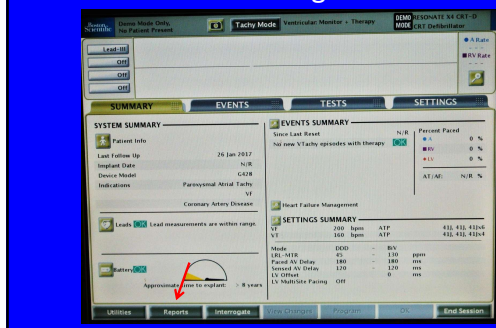
10-Step Interrogation Sequence

3. Print Baseline Settings

- Some programmers print automatically
 - Medtronic
 - St Jude
- Others require manual printing
 - Boston Scientific
 - Biotronik

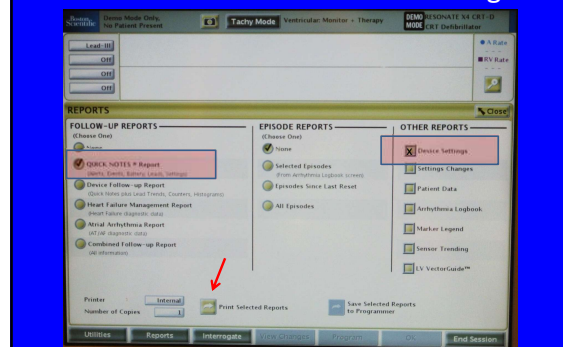
13

Printing Boston Scientific Baseline Settings



14

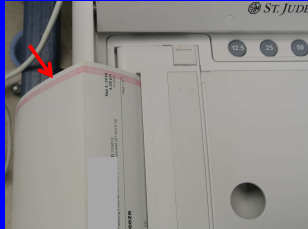
Print "Quick Notes + Device Settings"



15

Printer Request

- If you see red ink on the printed paper, please change it before ending the session



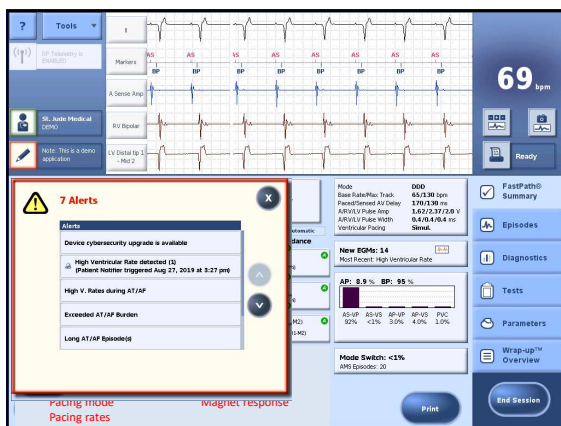
17

10-Step Interrogation Sequence

4. Review Baseline Information

- Presenting rhythm
- Alerts
- Battery life
- Pacing mode
- Pacing rates
- Percentage pacing
- Rate response mode sensor
- Special functions
- Magnet response

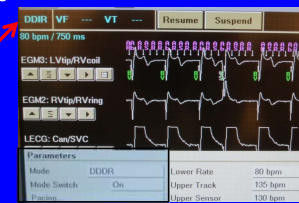
18



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Pacing Mode and Atrial Fibrillation

- The "Programmed" pacing mode may not be the ACTIVE mode if the pt is in A Fib/Flutter
 - Mode Switch function changes pacing mode and may change the rate



21

Rate Response Mode

- If there is a rate response mode active, determine the sensor type(s)

Rate Response Mode Sensor

Sensor	Manufacturer			
Accelerometer	Med	SJM	Bost	Bio
Minute Ventilation	-	-	Bost	-
Accel. + Min Vent	-	-	Bost	-
Ventricular Impedance	-	-	-	Bio

Med	Medtronic
SJM	St Jude Medical → Abbott
Bost	Boston Scientific
Bio	Biotronik

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Biotronik Rate Response Mode

- *DDDR* *Accelerometer*
- *DDD-CLS* *Ventricular impedance*

Bradycardia	
Mode	Current DDDR
Basic rate/Night rate [bpm]	60/OFF
Night begins	-----
Night ends	-----
Hysteresis [bpm]	OFF
Repetitive cycles	-----
Scan cycles	-----

Bradycardia	
Mode	Previous Current DDD-CLS
Basic rate/Night rate [bpm]	60/-----
Night begins	-----
Night ends	-----
Hysteresis [bpm]	OFF
Repetitive cycles	-----
Scan cycles	-----

24

The screenshot displays the 'Boston Sci. Programmer Report' interface. It is divided into several sections: 'Mode Settings', 'Output', and 'Rate Adaptive Pacing'. The 'Mode Settings' section on the left lists various parameters like 'Pacing Mode', 'Lower Rate Limit', and 'Maximum Tracking Rate'. The 'Output' section in the middle shows 'Trend 3.5 V @ 0.4 ms' and 'Fixed 0.75 mV'. The 'Rate Adaptive Pacing' section on the right indicates 'Ventilator Thresh. Response' is '70 %' and 'Accelerometer' is 'Passive'. A red box highlights the 'Rate Adaptive Pacing' section, and another red box highlights the 'Mode Settings' section. The 'Rate Adaptive Pacing' section also includes a 'Minute Ventilation' sensor status, which is 'On'.

Boston Sci. Programmer Report

Mode Settings

Mode: **DDDR**

RVT/MQV: **AAIR With VVI Backup**

Lower Rate Limit: **100 ppm**

Maximum Tracking Rate: **130 ppm**

Maximum Sensor Rate: **130 ppm**

Search Air Delay: **200-300 ms**

Sensor Air Delay: **200-300 ms**

A Refractory (PARAF): **240-280 ms**

V Refractory (VRP): **230-290 ms**

PARAF after PVC: **400 ms**

Air Search: **On**

Search Air Delay: **400 ms**

Search Interval: **30 cycles**

Blanking: **On**

A-Blank after V-Pace: **120 ms**

A-Blank after V-Sense: **45 ms**

A-Blank after A-Pace: **55 ms**

Magnet Response: **None Async**

Noise Response: **None**

Output

V

Sensitivity

Trend: **3.5 V @ 0.4 ms**

Fixed: **0.75 mV**

Fixed: **2.5 mV**

Leads

I

Pace: **Bipolar**

Sense: **Bipolar**

Safety Switch: **On**

V

Pace: **Bipolar**

Sense: **Bipolar**

Rate Adaptive Pacing

Minute Ventilation: **On**

Response Factor: **8**

Fixed Threshold: **6**

Ventilatory Threshold: **120 ppm**

Rate Adaptive Pacing

Ventilator Thresh. Response: **70 %**

Accelerometer: **Passive**

Page 3 of 4

4 of 5

Notice that the Mode DDDR indicates that a rate response mode is active. In the Rate Adaptive Pacing section you can find out which sensor is active. Note the Minute Ventilation sensor is on, the accelerometer is passive (off).

28

Special Functions

- Sleep/Rest modes
- MVP like modes

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Sleep/Rest Modes

<u>Manufacturer</u>	<u>Name</u>	<u>Mechanism</u>
• St Jude	Rest mode	Activity based
• Medtronic	Sleep rate	Time based
• Biotronic	Night rate	Time based
• Bost. Scient.	Hysteresis	HR based

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St Jude Programmer Report

Rest Rate ON

Basic Operation		
Mode	DDIR	Sensor
Magnet Response	Battery Test	Threshold
		Measured Avg
		Slope
		Measured Auto
		Max Sensor Rate
		Reaction Time
		Recovery Time

Rates	
Base Rate	60 bpm
Rest Rate	55 bpm
Max Sensor Rate	120 bpm

Hysteresis Rate

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Medtronic Programmer Report Sleep Rate ON

Initial Interrogation Report Page 7

Additional Features		Selectable Diagnostic	
Sleep	On	Chronic Lead Trend	On
Sleep Rate	40 ppm	High Rate Detail	
Bed Time	12:45:00 AM	Include Refractory Senses?	Include
Wake Time	7:00:00 AM	EGM Type	EGM
Single Chamber Hysteresis	Off	EGM Allocation	4 for 2/2 secs
Transcatheter Monitor	Off	EGM Timeout	6 weeks
Extended Telemetry	Off		
Extended Marker	Standard		
Implant Detection	Off/Complete		

Ventricular High Rate Episodes

Detection Rate	180 ppm
Detection Beats	5 beats
Termination Beats	5 beats
Episode Collection Method	Rolling

At 12:45 am her pacer's lower rate limit decreases from 50 to 40.

32

Biotronik Programmer Report Night Rate On

Bradycardia		Previous	Current
Mode			DDD
Basic rate/Night rate [bpm]			60/55
Night begins			00:00
Night ends			04:30
Hysteresis [bpm]			OFF
Repetitive cycles			-----
Scan cycles			-----
Sensor/Rate fading [bpm]		115/OFF	
Sensor gain			6
Automatic gain			OFF
Sensor threshold			Low
Rate fading			OFF

The key concept here is that if the pacer has a Night Rate active, and the HR slows after midnight, you do not need to worry about the pacemaker

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Programs to Minimize Ventricular Pacing

Manufacturer	Program Name
Medtronic	Managed Ventricular Pacing (MVP)
St Jude/Abbott	Ventricular Intrinsic Preference (VIP)
Bost Sci	RHYTHMIQ
Biotronik	Intrinsic Rhythm Support (IRS)

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Medtronic MVP Programmed On

Parameters		Atrial Lead		Ventricular Lead	
Mode	AAIR+---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...	5.00 mV
Upper Track	130 ppm	Pace Polarity...	Bipolar	Pace Polarity...	Bipolar
Upper Sensor	130 ppm	Sense Polarity...	Bipolar	Sense Polarity...	Bipolar

AAIR+ indicates that backup ventricular pacing is available

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St Jude Ventricular Intrinsic Preference (VIP) Report

Freeze Capture	
Jun 13, 2012 8:06 am	
Key Parameters	
Mode	DDD
Base Rate	60 bpm
Rest Rate	Off
Paced AV Delay	250 ms
Sensed AV Delay	225 ms
Max Track Rate	120 bpm
Max Sensor Rate	120 bpm
Hysteresis Rate	Off
ACap® Confirm	Monitor
V AutoCapture	Off
Ventricular Intrinsic Preference (VIP®)	On
Negative R-T Hysteresis Search	Off
Rate Responsive AV Delay	Off
Rate Responsive PVARP/Ref	High
Ventricular Safety Standby	On

As you read the key parameters, you will see VIP is ON

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Boston Sci. Programmer Report RHYTHMIQ

Settings		Output	
Mode	DDDR	● A	Trend 3.5 V @ 0.4 ms
RHYTHMIQ™	AAIR With VVI Backup	■ V	Trend 3.5 V @ 0.4 ms
Lower Rate Limit	50 ppm	● A	Fixed 0.75 mV
Maximum Tracking Rate	130 ppm	■ V	Fixed 2.5 mV
Maximum Sensor Rate	130 ppm	● A	
Paced AV Delay	220 - 300 ms	Leads	
Sensed AV Delay	220 - 300 ms	● A	Pace
A-Refractory (PVARP)	240 - 280 ms	■ V	Sense
V-Refractory (VRP)	230 - 250 ms	● A	Safety Switch
PVARP after PVC	400 ms	■ V	Pace
AV Search	On	● A	Sense
Search AV Delay	400 ms	■ V	Safety Switch
Search Interval	32 cycles	● A	Pace
Blanking		■ V	Sense
A-Blank after V-Pace	125 ms	● A	Safety Switch
A-Blank after V-Sense	45 ms	■ V	Pace
V-Blank after A-Pace	65 ms	● A	Sense
Magnet Response	Pace Async	■ V	Safety Switch
Noise Response	DDO	● A	Pace
		■ V	Sense
		● A	Rate Adaptive Pacing
		■ V	Minute Ventilation
		● A	Response Factor
		■ V	Fitness Level
		● A	Ventilatory Threshold

Page 3 of 5

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Mode Switch Function

- Devices programmed in the DDD(R) mode will have a mode switch function
 - Usually in the background ready to go
 - But ON if the patient is in AF
- Determine the following parameters:
 - Mode
 - Rate
 - Cut off rate

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St Jude Mode Switch Example

Basic Operation	
Mode	DDD
Ventricular Pacing	LV-RTV - 80 ms
V. Triggering	Off
Magnet Response	Normal
V. Noise Reversion Mode	Pacing Off
Episodic Pacing Mode	DDI
Sensor	Passive
Threshold (Measured Avg)	Auto (0-5) (2.0)
Slope (Measured Auto)	Auto (+2) (9)
Max Sensor Rate	130 bpm
Reaction Time	Fast
Recovery Time	Medium
Rates	
Base Rate	60 bpm
Rest Rate	Off
Max Sensor Rate	130 bpm
Max Track Rate	130 bpm
Hysteresis Rate	Off
2:1 Block Rate	148 bpm

Refractories & Blanking	
PVARP	275 ms
Post-Vent. Atrial Blanking	200 ms
Rate Responsive PVARP/Ref	Off
AV Pace Refractory	220/220 ms
AV Sense Refractory	95/125 ms
Ventricular Blanking	52 ms
Ventricular Safety Standby	On
Arrhythmia Unfolding	3 intervals
PVC Response	Off
PMT Response	Atrial Pace
PMT Detection Rate	110 bpm

AT/AF Detection & Response	
Auto Mode Switch	DDI
AMS V. Triggering	Off
A. Tachycardia Detection Rate	180 bpm
AMS Base Rate	80 bpm
AF Suppression/tx	Off

St Jude: Auto Mode Switch

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Biotronik Programmer Report Mode Switch Information

Mode switching [bpm]	160/DDIR
Intervention rate [bpm]	160
Switch to	DDIR
Onset criterion [out of 8]	5
Resolution criterion [out of 8]	5
Change of basic rate [bpm]	+10
Rate stabilization during mode switching	OFF
2:1 Lock-in protection	ON
Vp suppression	OFF

40

Medtronic Mode Switch

- Always converts to DDIR and the rate does not change
- Not denoted in the report so just need to remember this

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Magnet Response Options

- ICDs
 - St Jude and Boston Scientific can be programmed to ignore the magnet
- Pacemaker
 - Rate depends on the device manufacturer and the remaining battery life
 - St Jude devices can be programmed to ignore magnet
 - Biotronik devices have 3 possible responses

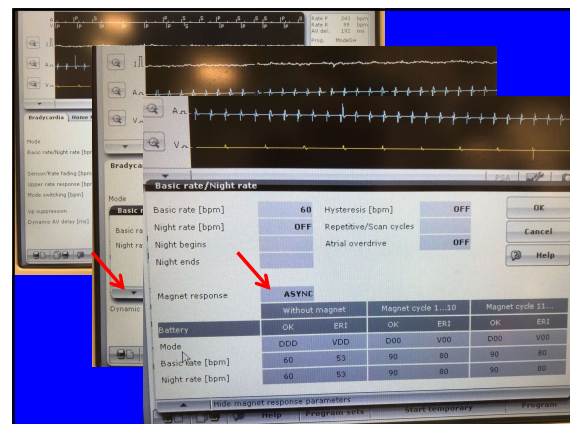
43

Important Biotronik Message

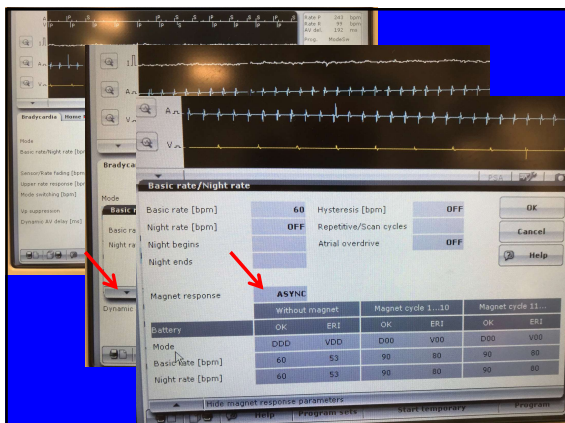
- 3 Possible Magnet Responses:
 - Auto Asynchronous pacing for 10 cycles
 - Async Asynchronous pacing indefinitely
 - Sync No response to magnet

Do you remember how to determine the Magnet Response?

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45



46

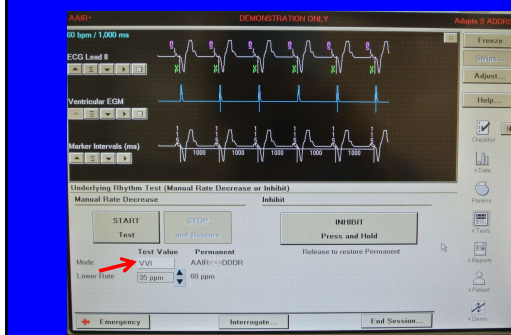
10-Step Interrogation Sequence

5. Determine Underlying Rhythm

- If pt is paced, determine if pacer dependent
- Use DDI @ 35 bpm or inhibit pacer completely
- Record a programmer strip chart while checking

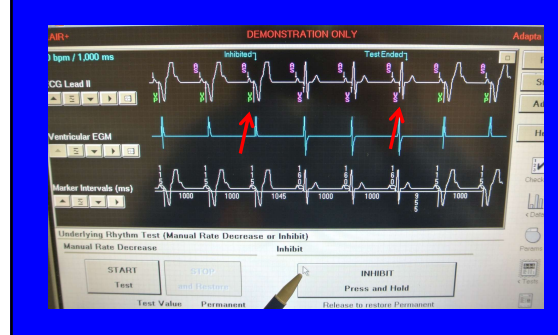
48

Medtronic Underlying Rhythm Test



52

Medtronic Checking Underlying Rhythm II



53

Manual Printer Activation



54

Warning

- When checking the patient's underlying rhythm, make sure that you watch the patient's EKG or pulse (sat signal or a-line) in addition to the electrogram to avoid prolonged asystole

56

10-Step Interrogation Sequence

6. Test the Leads

- Lead Impedance
- Sensing Amplitudes
- Capture Thresholds

57

10-Step Interrogation Sequence

6. Test the Leads

- Lead tests designed to identify dysfunctional leads or significantly changing myocardium
- Most devices check these measurements daily or upon an interrogation, but get in the habit of checking them manually

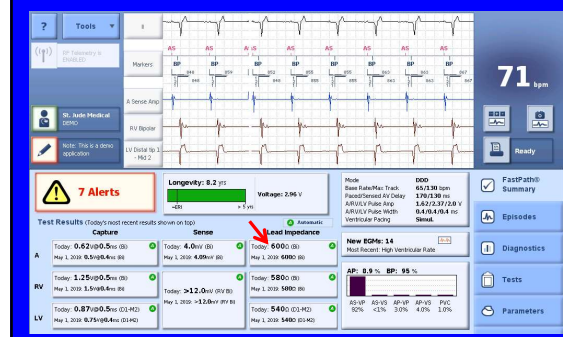
58

Lead Impedance Testing

- General guidelines
 - Pacing Leads
 - 200-1000 ohms
 - ICD leads
 - 25-100 ohms
- Look at trends if any question

60

Checking Impedance—St Jude

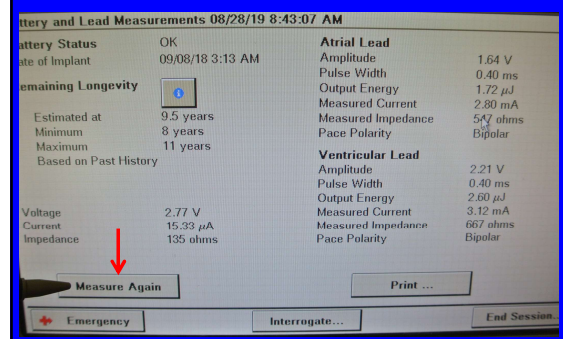


69



70

Checking Impedance--Medtronic



71

Sensing Amplitude Testing

- Measure the amplitude of the sensed intrinsic P and R waves
 - Must ensure that amplitudes (mV) are 2x greater than the sensitivity settings

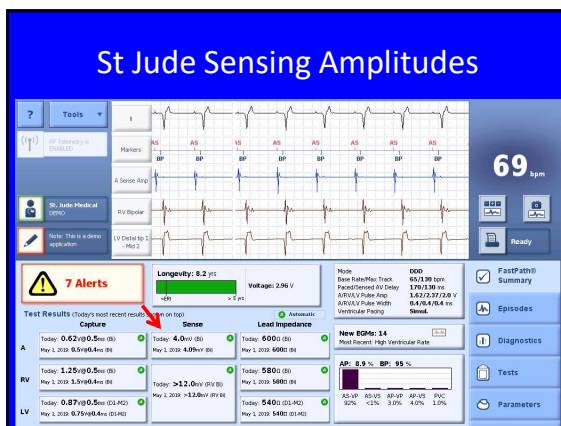
72

Sensing Amplitude Testing General Concepts

- Typically use DDD at 35 with long PR-interval (350 msec)
 - Use VVI if in AF
- If patient had no underlying rhythm, do not do this test

73

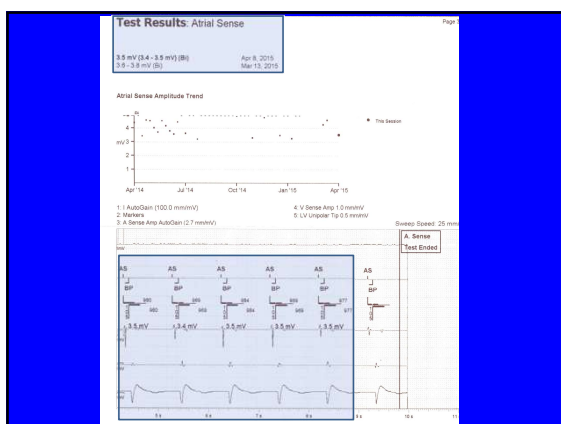
St Jude Sensing Amplitudes



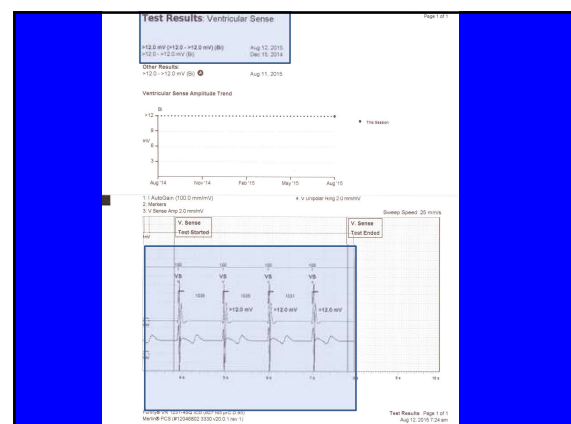
80



81



82



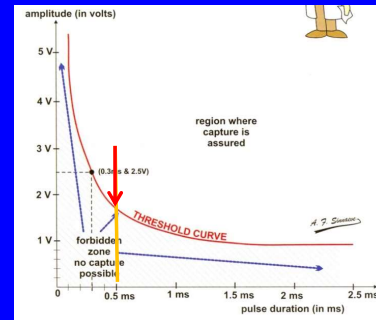
83

Capture Threshold Testing

- Determine the lowest amount of volts required to capture each chamber with the programmed pulse wave duration

84

Capture Threshold Testing



85

Capture Threshold Testing

- Use Auto-Decrement Amplitude option
- Start with amplitude 1-1.5 V above most recent threshold result
- Use HR 10-20 bpm above the patient's present rate if patient not pacing at baseline

LOC=Loss of Capture

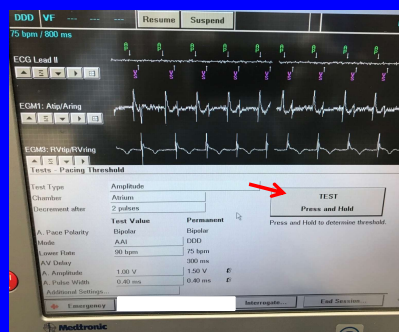
87

Atrial Capture Thresholds

- Use DDD with long AVI if AV conduction unreliable
 - AP-VP
 - AS-VP
- May use AAI if AV conduction is OK
 - AP-VS
 - AS-VS
- Best to watch a lead that demonstrates the P-wave

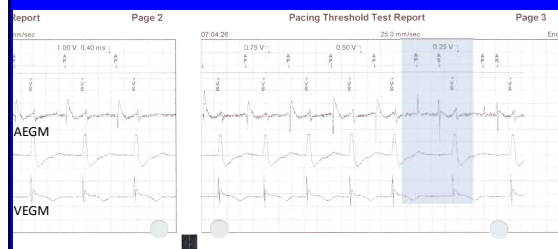
88

Atrial Capture Threshold



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Atrial Capture Test Result



Do you see where the atrial capture first failed?

90

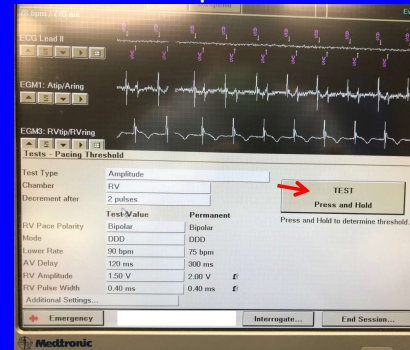
Ventricular Capture Threshold

- Use DDD with a short AVI (100-120 ms) if the patient has an atrial rhythm
 - May use VVI if pt in AF or has only a ventricular lead

The use of DDD rather than VVI maintains the patient's atrial kick when present

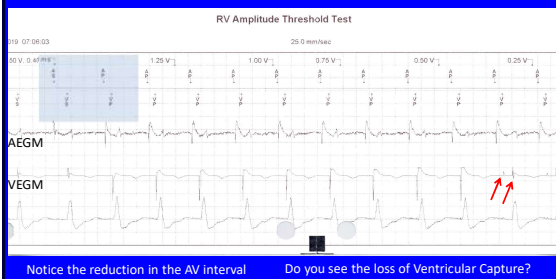
91

Ventricular Capture Threshold



92

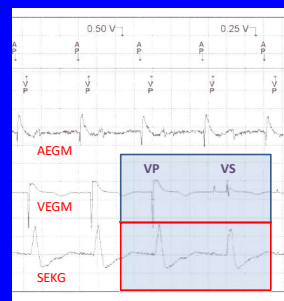
Ventricular Capture Threshold Result



Notice the reduction in the AV interval Do you see the loss of Ventricular Capture?

93

Ventricular Capture Threshold



- Notice the difference b/n the paced and sensed ventricular depolarizations on the VEGM
- Notice the lack of difference on the SEKG
- Set up monitor to provide VEGM and SEKG in close proximity
- Always harder to determine LOC real-time

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Important Message

- When doing capture thresholds, make sure you have a way to monitor the patient in addition to the programmer electrogram

95

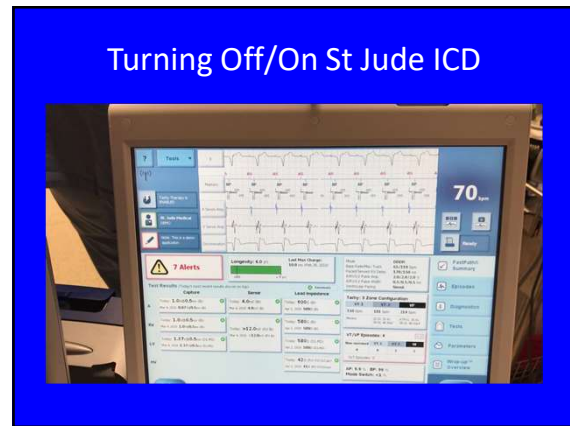
10-Step Interrogation Sequence

7. **Make programming adjustments for Surgery**
 - Turn off the ICD (suspend anti-tachy therapy)
 - Change pacing mode or rate
 - Increase pacing output
 - Turn off special functions
 - Sleep/Rest/Night rates
 - MVP/VIP modes
 - Adjust magnet response
 - Biotronik

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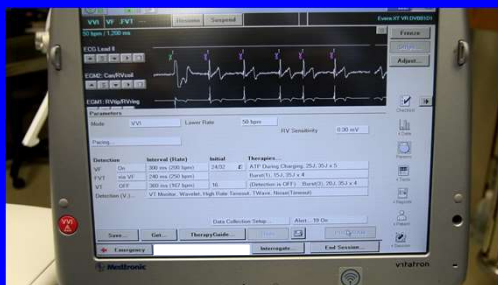


97



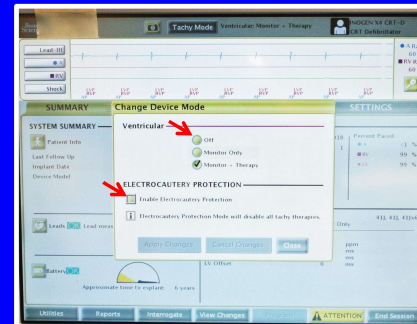
98

Turning Off Medtronic ICD



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Boston Scientific ICD Reprogramming

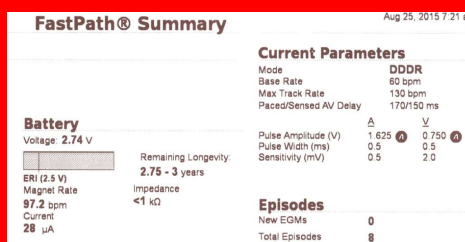


Ventricular (Tachy) is programmed as Monitor + Therapy

100

Important Reminder

- Print baseline settings before making any programming changes



101

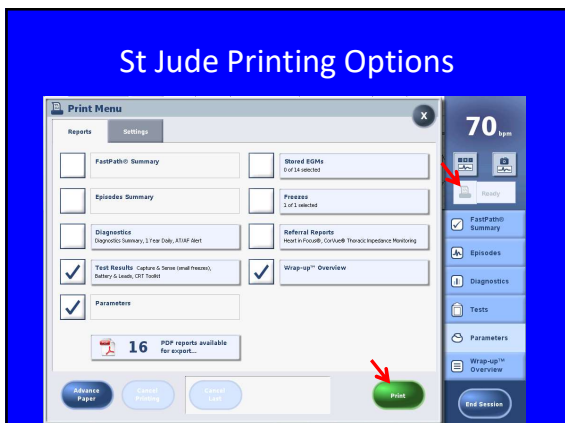
10-Step Interrogation Sequence

8. Print final interrogation report and settings changes

- This will include results from lead tests and the programming changes you made

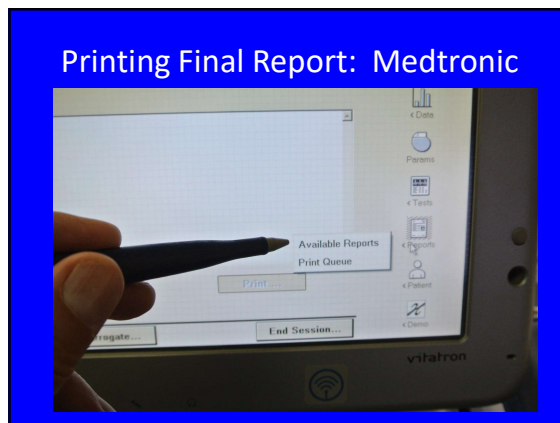
102

St Jude Printing Options



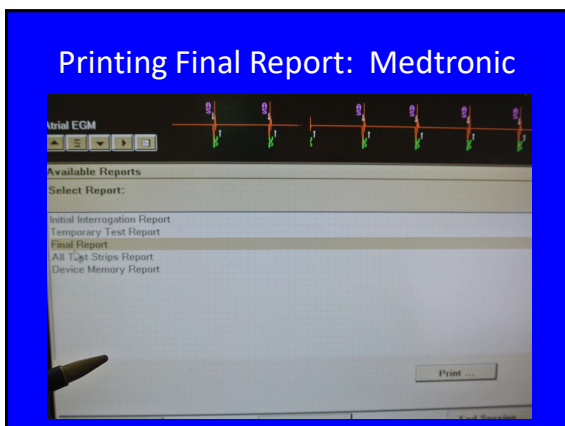
104

Printing Final Report: Medtronic



105

Printing Final Report: Medtronic



106

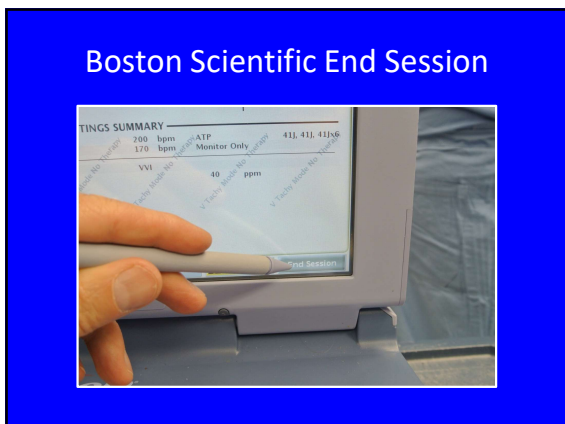
10-Step Interrogation Sequence

9. End the Programmer Session

- Always end the session prior to turning off the programmer
 - This often requires a confirmation that you want the ICD inactivated

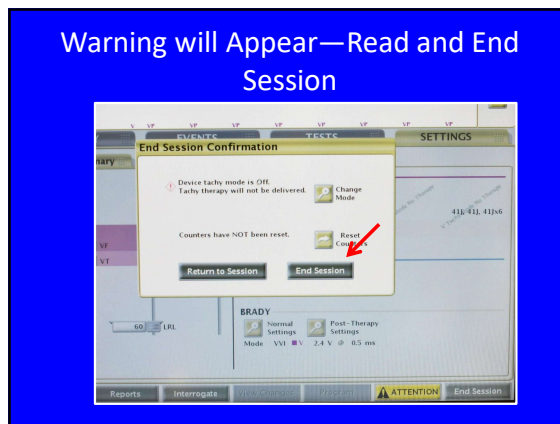
107

Boston Scientific End Session



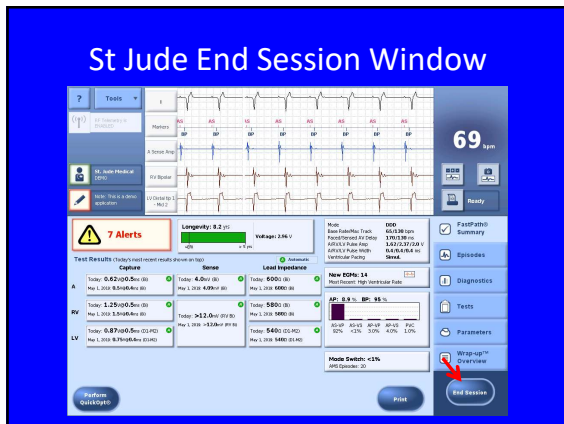
108

Warning will Appear—Read and End Session



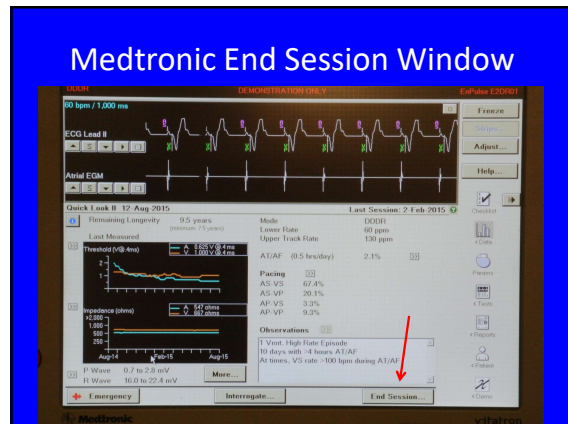
109

St Jude End Session Window



110

Medtronic End Session Window



111

Older Medtronic Pacemakers



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10-Step Interrogation Sequence

10. Document

- Enter note in EPIC
- Record what you did in your log book
- Place programmer report in paper chart/upload electronic report into EPIC

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10-Step Interrogation Review

1. Determine device manufacturer
2. Initiate interrogation with appropriate programmer
3. Print baseline settings
4. Review baseline information
5. Check underlying rhythm
6. Test the leads
7. Make indicated programming changes for surgery
8. Print final settings
9. End session
10. Document

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Post Op Interrogation Reminder

- If you interrogate a device post op, always reprogram the device to its baseline settings as soon as the interrogation is started—then test the leads etc.
 - Especially when you have turned off a patient's Anti-Tachy Therapy
 - It is possible to get distracted by an issue and to forget to turn on a patient's ICD or RRM

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Summary

- Develop an interrogation sequence and use it every time
- A well prepared programmer cart makes your life much easier
- Always print baseline settings before making programming changes
- Be very careful when determining underlying rhythm and capture thresholds
- Print the final report
- Make sure you end the programming session
- Document
- Enjoy the process helping your colleagues

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The End

Yosemite NP at Midnight

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