Perioperative Electrophysiology:

Perioperative Device Interrogation: How does an Anesthesiologist do it?

Scott Streckenbach, MD
Cardiac Anesthesia Group
Director, Perioperative Electrophysiology Service
Massachusetts General Hospital

I have no conflict of Interest

1

Overview

- I will describe a 10-step sequence you may use to interrogate pacers or ICDs
  - Systematic
  - Comprehensive
  - Efficient

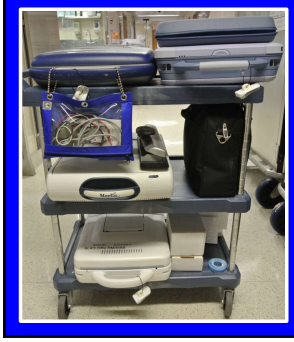
2

10-Step Interrogation

1. Get the Cardiac Anesthesia Programmer Cart
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

5

Cardiac Anesthesia Programmer Cart



- Programmers with pacing leads
- Extra paper for each programmer
- Hole punch
- Magnet
- EKG electrodes
- Sani-wipes

6

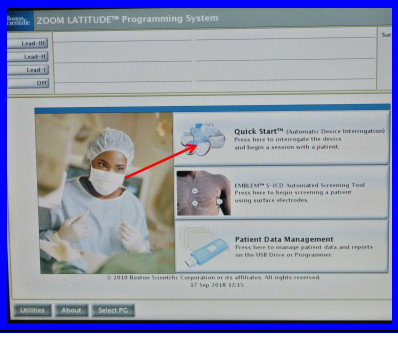
10-Step Interrogation Sequence

2. Initiate Interrogation with Programmer

- Ensure patient is monitored
- Place programmer wand over patient's pacer or ICD

7

Boston Scientific



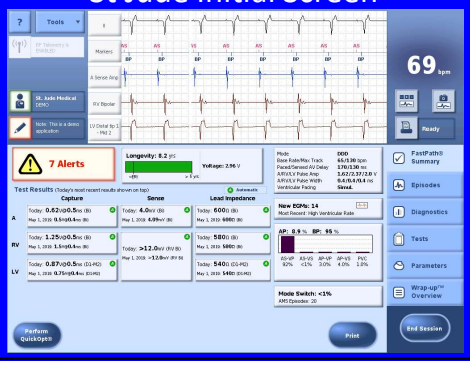
9

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

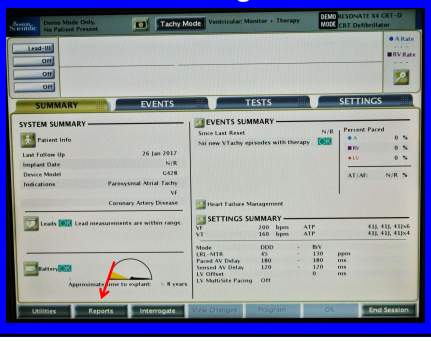
3. Print Baseline Settings

– Some programmers print automatically
- Medtronic
- St Jude

– Others require manual printing
- Boston Scientific
- Biotronik

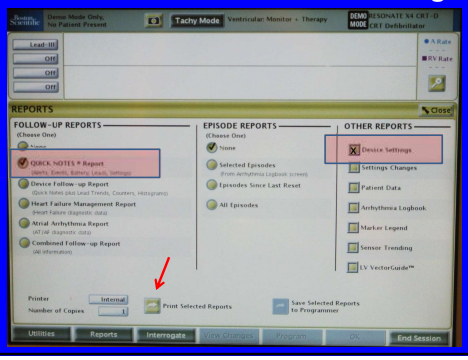
13

Printing Boston Scientific Baseline Settings



14

Print "Quick Notes + Device Settings"



15

Printer Request

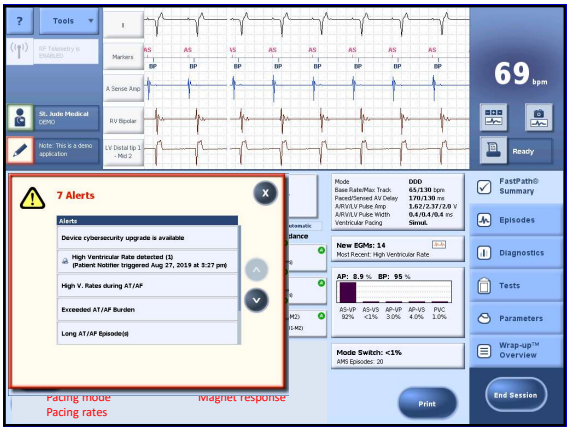
- *If you see red ink on the printed paper, please change it before ending the session*

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

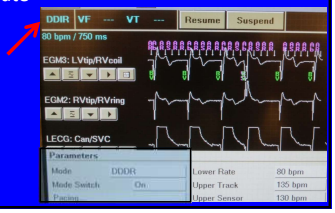
18



19

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)

22

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

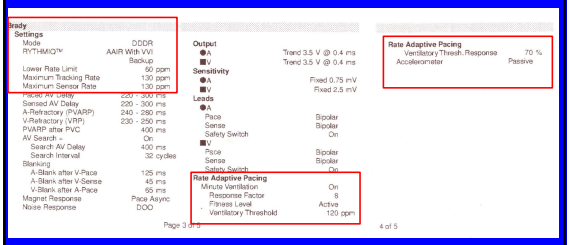
23

Biotronik Rate Response Mode

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

24

Boston Sci. Programmer Report



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

29

Sleep/Rest Modes

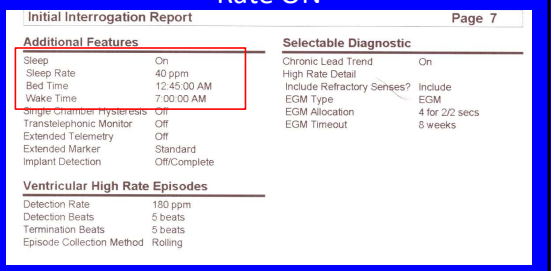
Manufacturer	Name	Mechanism
• St Jude	Rest mode	Activity based
• Medtronic	Sleep rate	Time based
• Biotronik	Night rate	Time based
• Bost. Scient.	Hysteresis	HR based

30

St Jude Programmer Report Rest Rate ON

31

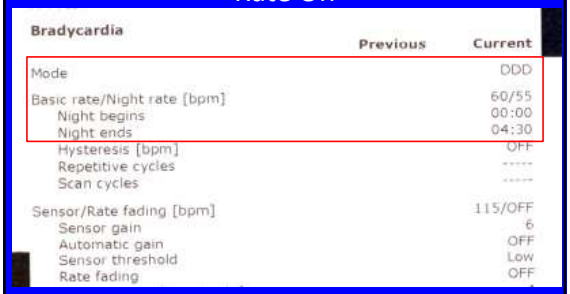
Medtronic Programmer Report Sleep Rate ON



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

32

Biotronik Programmer Report Night Rate On



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

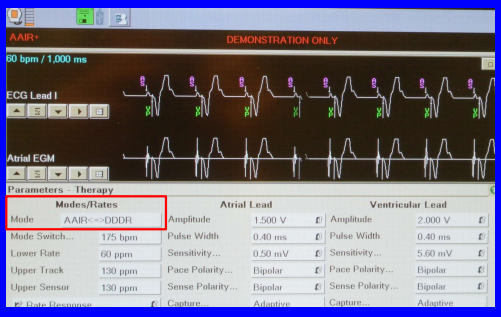
33

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)

34

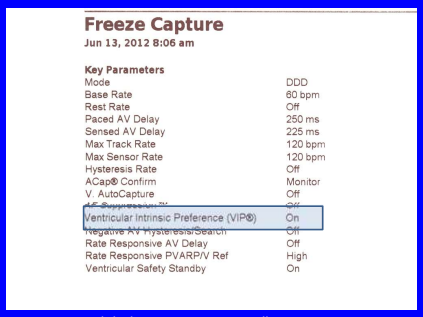
Medtronic MVP Programmed On



AAIR+ indicates that backup ventricular pacing is available

35

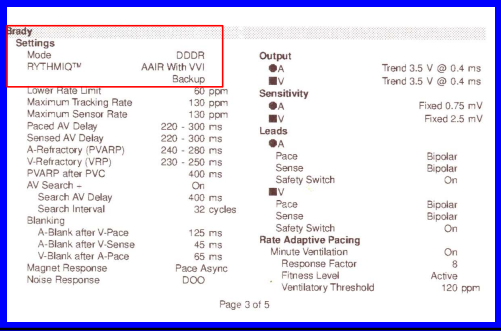
St Jude Ventricular Intrinsic Preference (VIP) Report



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

36

Boston Sci. Programmer Report RHYTHMIQ



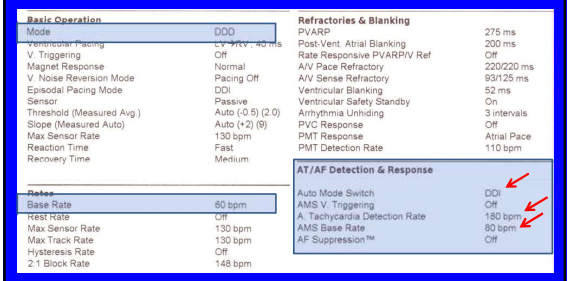
37

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

38

St Jude Mode Switch Example



Basic Operation	
Mode	DDD
V. Triggering	Off
Magnet Response	Normal
V. Noise Reversion Mode	Pacing Off
Episodal 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/V Ref	Off
A/V Pace Refractory	220/220 ms
A/V Sense Refractory	93/125 ms
Ventricular Blanking	52 ms
Ventricular Safety Standby	On
Arrhythmia Unhiding	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™	Off

St Jude: Auto Mode Switch

39

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

41

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

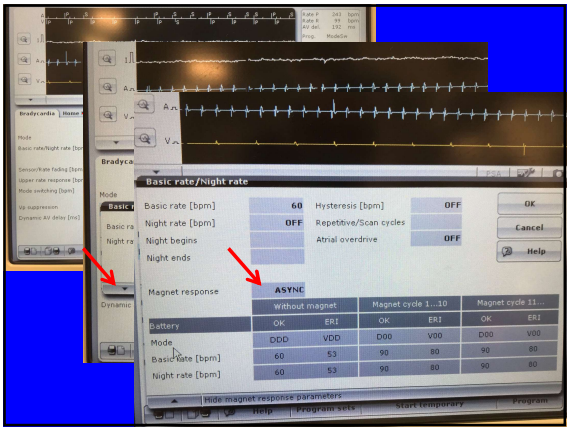
43

Important Biotronik Message

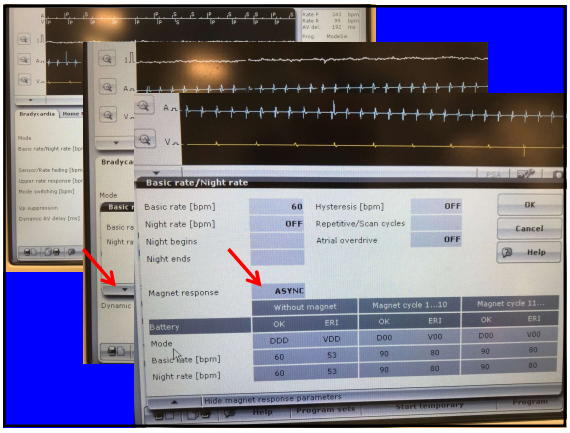
- 3 Possible Magnet Responses:
  - Auto Asynchronous pacing for 10 cycles
  - Async Asynchronous pacing indefinitely
  - Sync No response to magnet

Do you remember how to determine the Magnet Response?

44



45



46

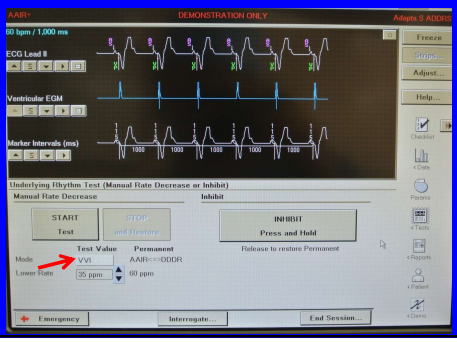
10-Step Interrogation Sequence

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

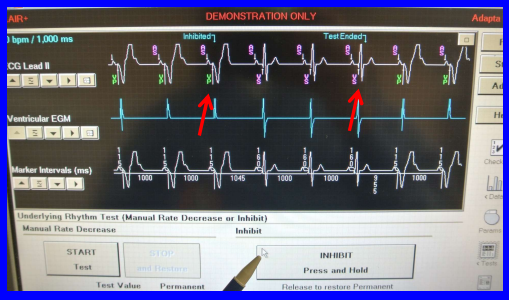
48

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

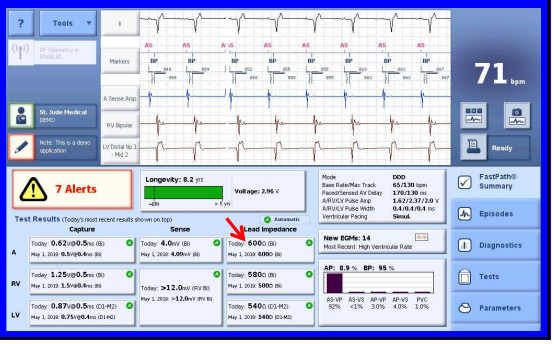
58

Lead Impedance Testing

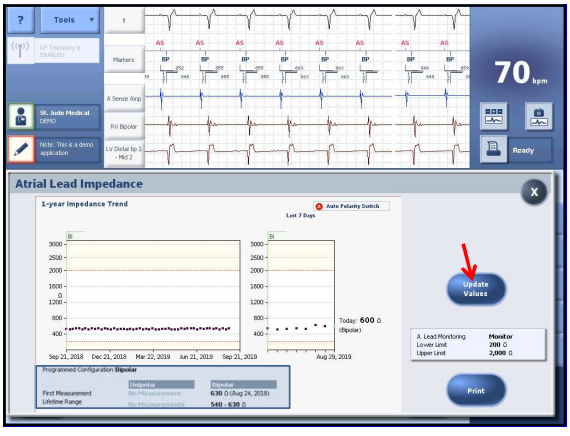
- General guidelines
  - Pacing Leads
    - 200-1000 ohms
  - ICD leads
    - 25-100 ohms
- Look at trends if any question

60

Checking Impedance—St Jude

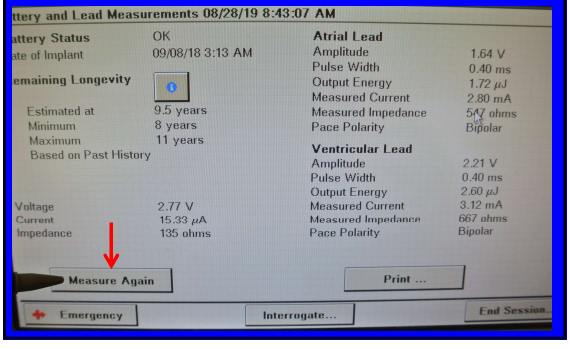


69



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

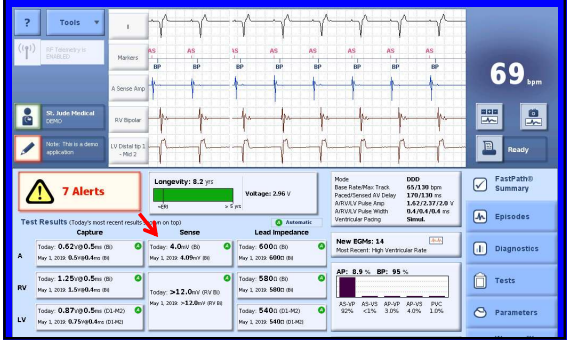
72

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

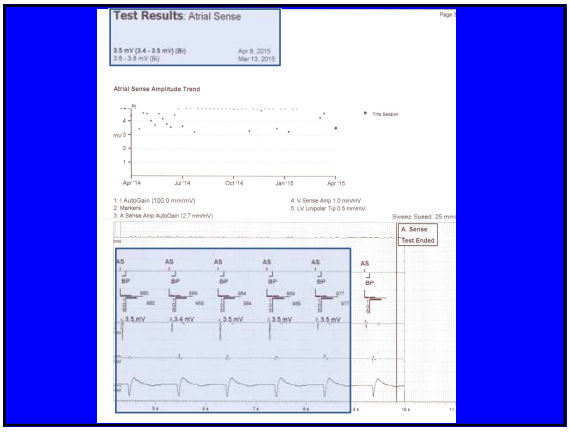
73

St Jude Sensing Amplitudes

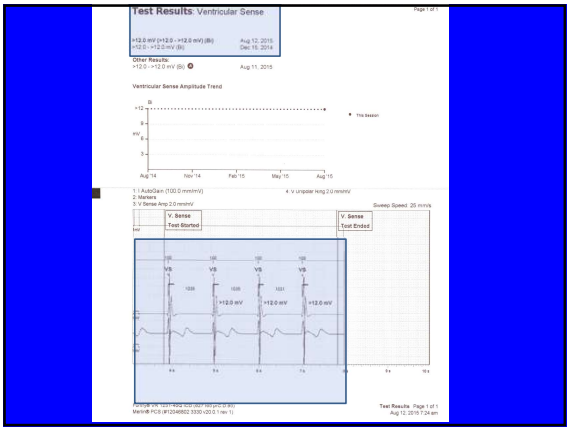


80

81



82



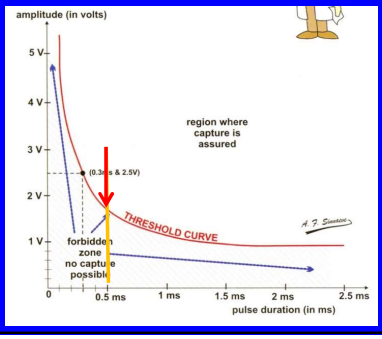
83

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

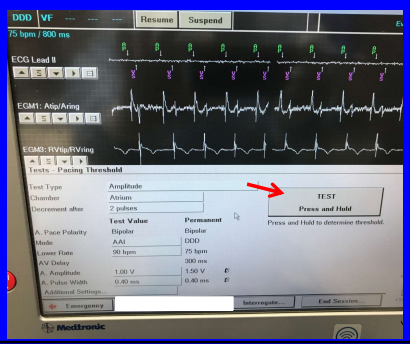
87

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

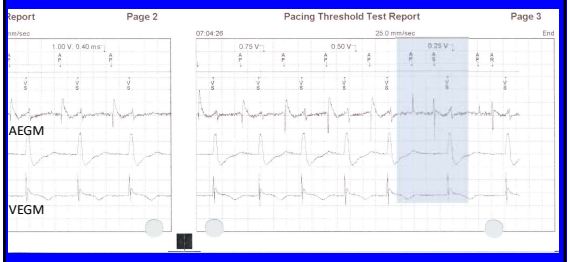
88

Atrial Capture Threshold



89

Atrial Capture Test Result



Do you see where the atrial capture first failed?

90

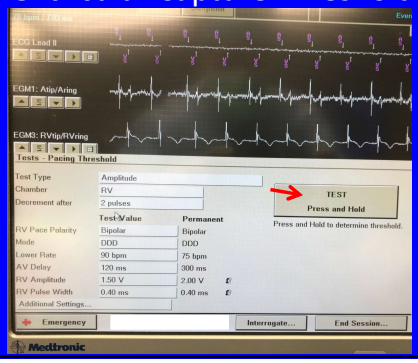
Ventricular Capture Threshold

- 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

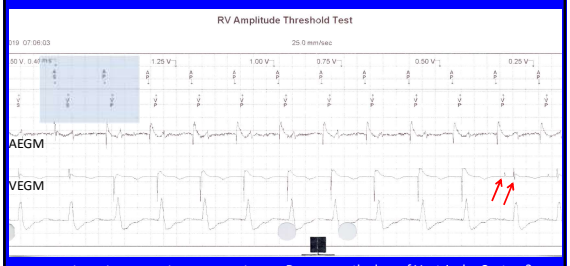
91

Ventricular Capture Threshold



92

Ventricular Capture Threshold Result

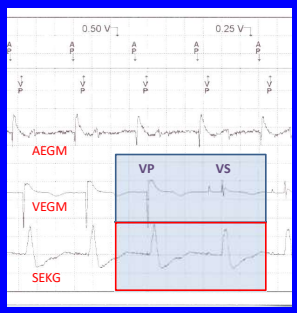


Notice the reduction in the AV interval

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

94

Important Message

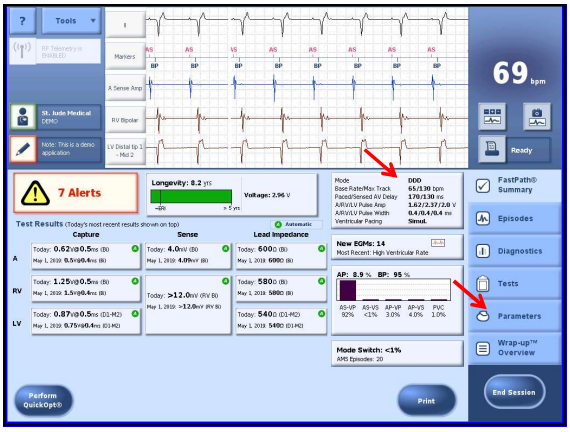
- When doing capture thresholds, make sure you have a way to monitor the patient in addition to the programmer electrogram

95

10-Step Interrogation Sequence

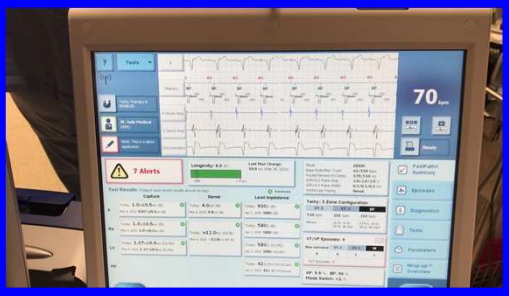
7. **Make programming adjustments for Surgery**
   - Turn off the ICD (suspend anti-tachy therapy)
   - Change pacing mode or rate
   - Increase pacing output
   - Turn off special functions
     - Sleep/Rest/Night rates
     - MVP/VIP modes
   - Adjust magnet response
     - Biotronik

96



97

Turning Off/On St Jude ICD

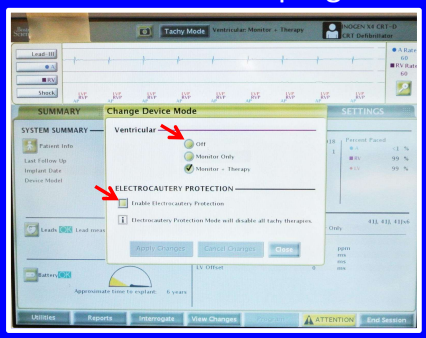


98

Turning Off Medtronic ICD

99

Boston Scientific ICD Reprogramming

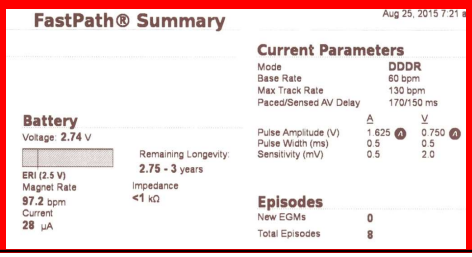


Ventricular (Tachy) is programmed as Monitor + Therapy

100

Important Reminder

- Print baseline settings before making any programming changes



101

10-Step Interrogation Sequence

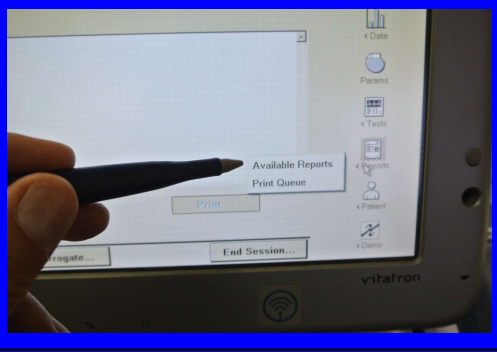
8. **Print final interrogation report and settings changes**
   - This will include results from lead tests and the programming changes you made

102

St Jude Printing Options

104

Printing Final Report: Medtronic



105

Printing Final Report: Medtronic

106

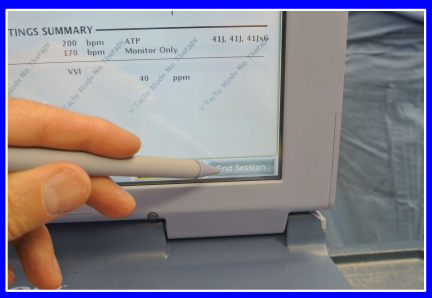
10-Step Interrogation Sequence

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

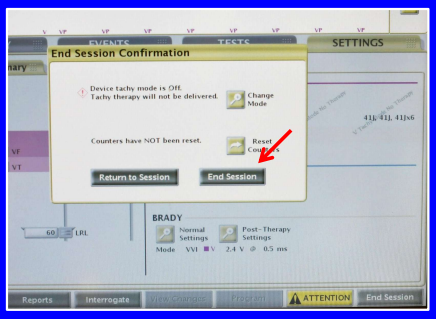
107

Boston Scientific End Session



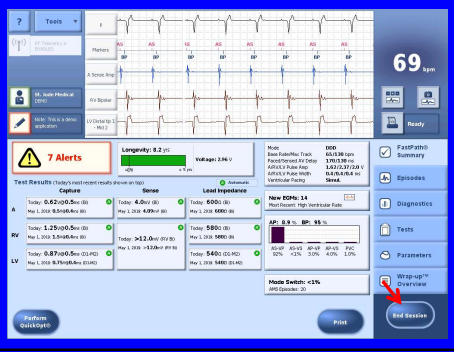
108

Warning will Appear—Read and End Session



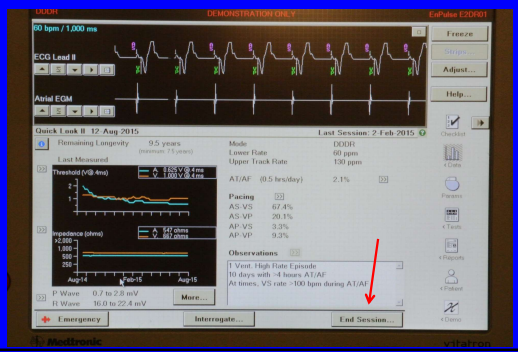
109

St Jude End Session Window



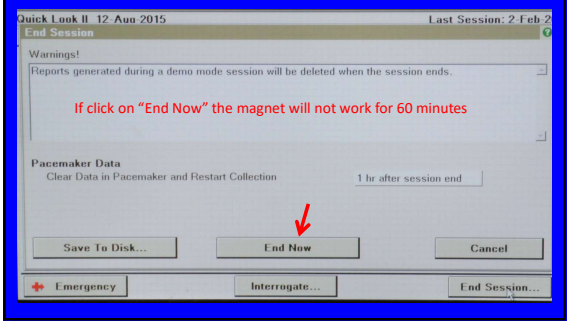
110

Medtronic End Session Window



111

Older Medtronic Pacemakers



112

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

113

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

121

Post Op Interrogation Reminder

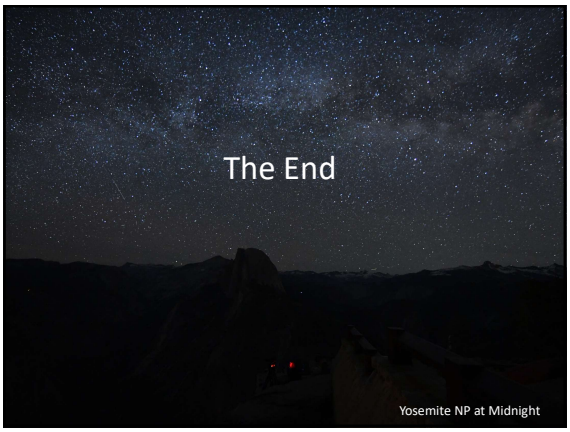
- If you interrogate a device post op, always reprogram the device to its baseline settings as soon as the interrogation is started—then test the leads etc.
  - Especially when you have turned off a patient's Anti-Tachy Therapy
  - It is possible to get distracted by an issue and to forget to turn on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

122

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

123



124