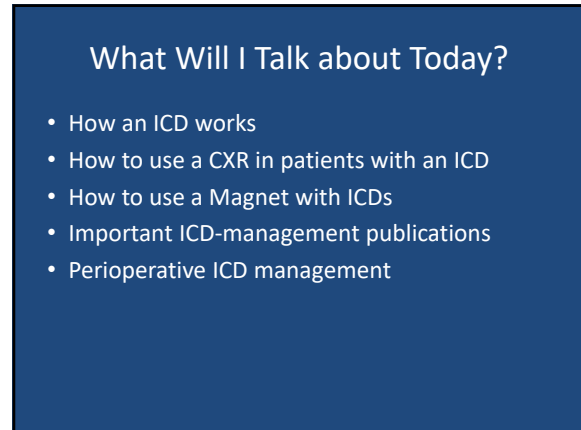
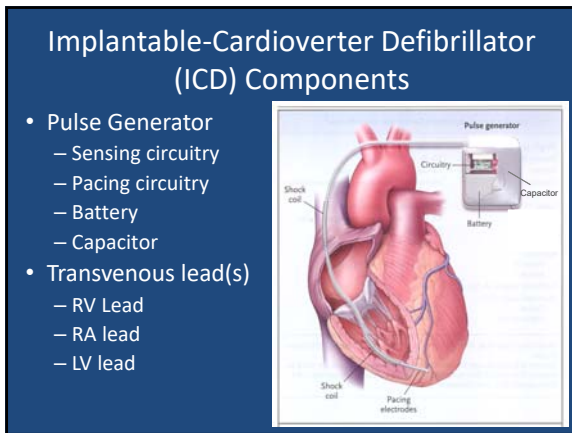




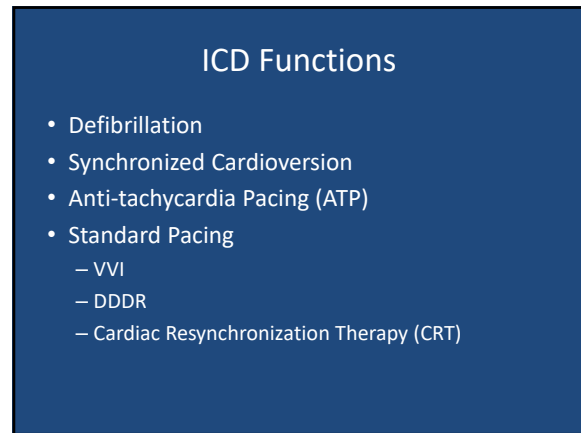
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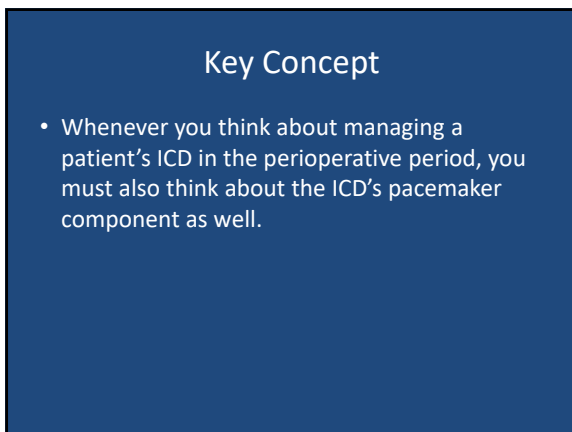
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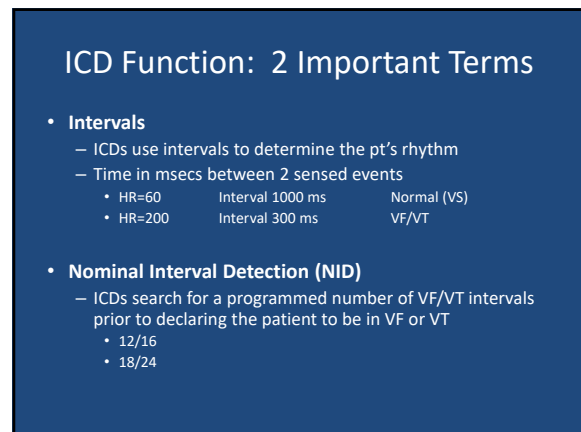
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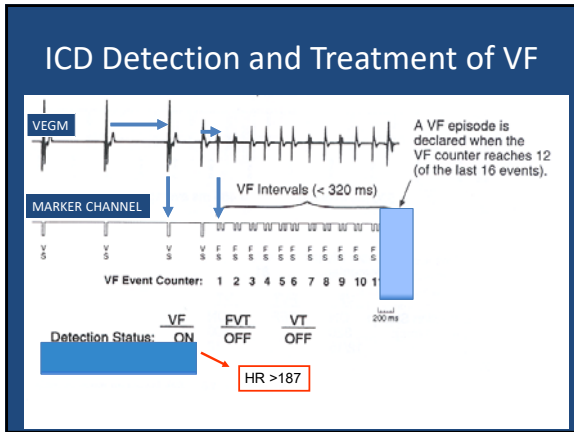
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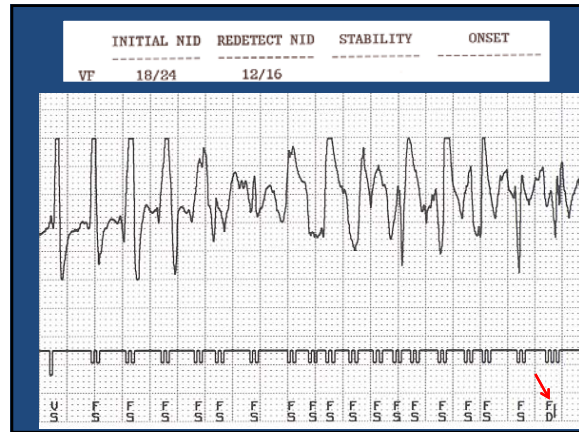
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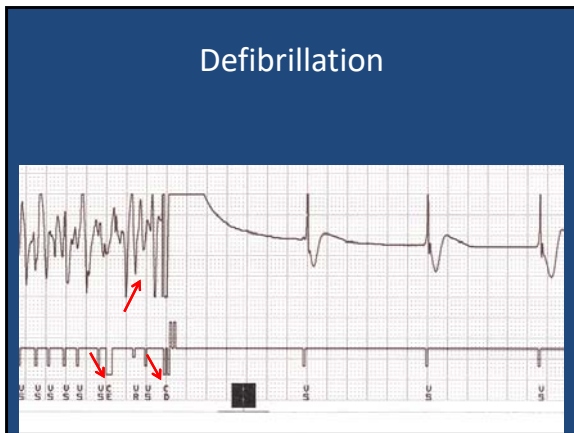
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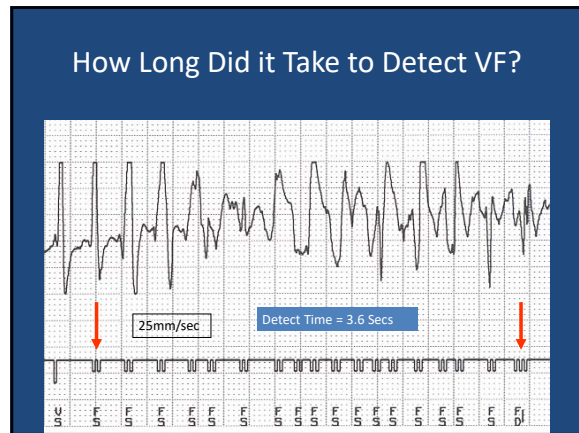
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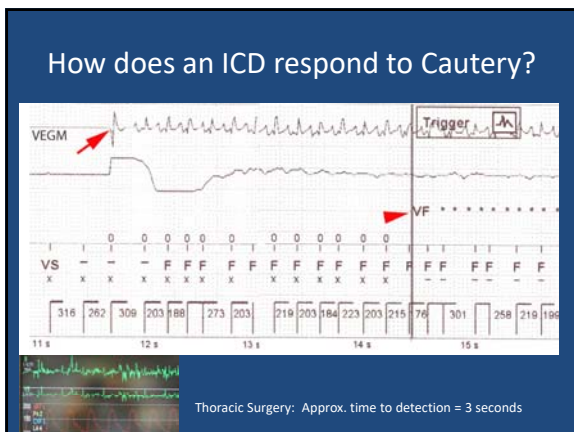
12



13



14



15

Key Concepts

- ICDs can detect VF within 2-4 seconds
- ICDs can misinterpret surgical cautery as VF and deliver ATP or shocks

16

Treatment Zones, Cut Off Rates and Treatment Algorithms

Tx Zone	Cut Off Rate	Tx Algorithm
VF	200 bpm (300 ms)	ATP while charging 30 J shock, 36 J x 5
Fast VT	180 bpm (333 ms)	ATP x 3
Slow VT	150 bpm (400 ms)	25 J, 30 J, 36 J x2 Monitor Only

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Medtronic ICD Treatment Zones

Detection	Interval (Rate)	Initial	Therapies...
VF On	300 ms (200 bpm)	2402	ATP During Charging, 25J, 35J x 5
VF via VF	240 ms (250 bpm)		Burst(1), 15J, 35J x 4
FVT OFF	360 ms (167 bpm)	16	(Detection is OFF) Burst(3), 20J, 35J x 4
VT Monitor			VT Monitor, Wavelet, High Rate Timeout, TWave, Noise(Timeout)

18

St Jude ICD Treatment Zones

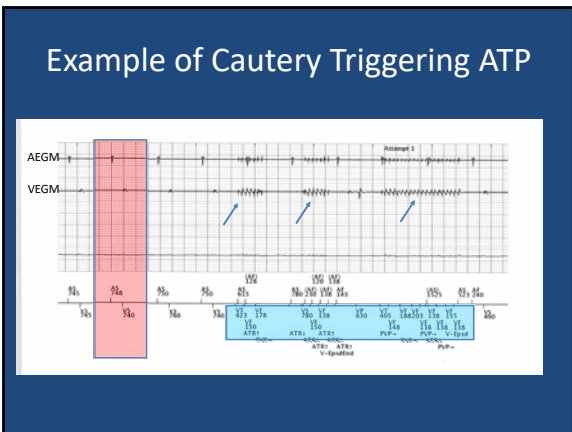
	VT-1	VT-2	VF
Rate	140 bpm	160 bpm	182 bpm
ATP	ATP(3), 30J, 36J, 36J	ATP(3), 30J, 36J, 36J	ATP(3), 30J, 36J, 36J
Wavelet	36J	36J	36J

19

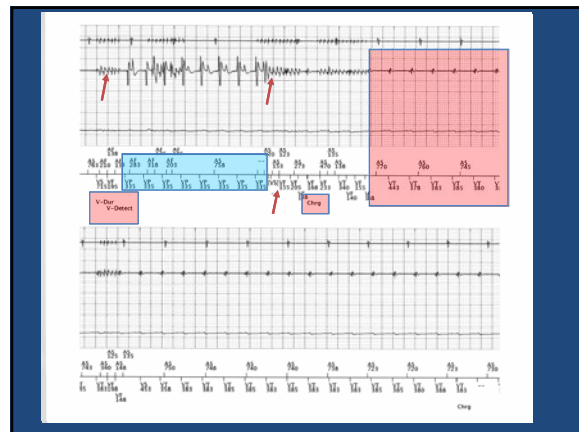
Boston Scientific ICD Treatment Zones

	VF	VT	ATP	ATP
VF	On	200 bpm	ATP	41J, 41J, 41J x6
VT	Off	160 bpm	ATP	41J, 41J, 41J x4

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21



22

Key Concepts

- Cautery can cause inappropriate ATP
- Inappropriate ATP can cause actual VT

24

How to Use a CXR

1. Determine if the patient has an ICD
2. Determine the ICD's manufacturer

25

Which CXR has the ICD?

27

Pacemaker vs ICD CXR

28


What type of ICD is this?

30

What is this?

31

Determination the ICD's Manufacturer



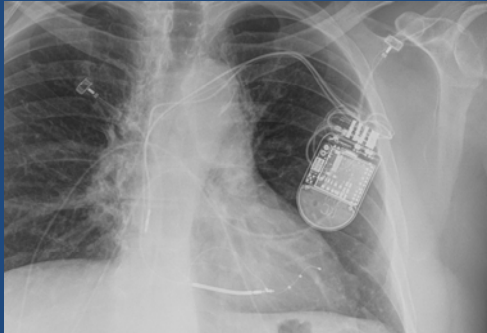
SJM Biotronik Medtronic Bos Sci

- Each Manufacturer has a characteristic CXR identifier—alphabetic or symbolic

Jacob et al, Heart Rhythm Vol 8 No 6 June 2011, p.918


33

St Jude



34

St Jude/Abbott




SJM

Ellenbogen, Clin Cardiac Pacing 4th ed., p.778

35

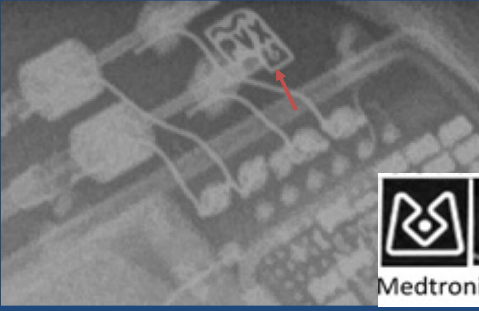
Biotronik



Biotronik

36

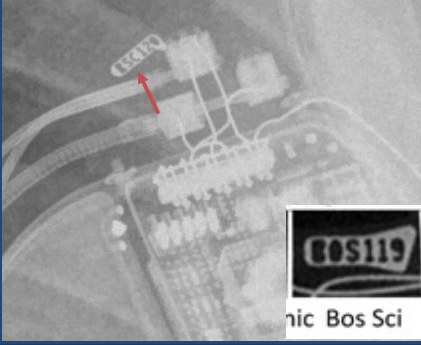
Medtronic



Medtronic

37

Boston Scientific

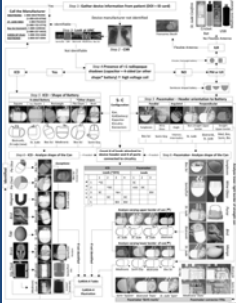


BOS119
nic Bos Sci

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CaRDIA-X CXR Algorithm

If the identifier is not visible, you have other options




CREATIVE CONCEPTS
Cardiac Rhythm Device Identification Algorithm using X-Rays: CaRDIA-X
 Tony Jacob, MD, Muhammad A. Shaheed, MD, Rahul Mukherjee, BS, Siddiqui S. Parvaz, MD, Rajeev Arora/Halderman, MD

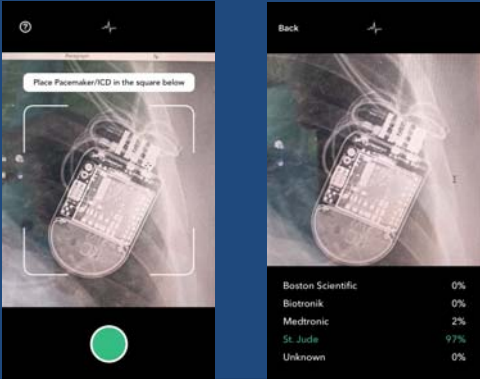
Jacob et al, Heart Rhythm Vol 8 No 6 June 2011, p.918

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Pacemaker ID App



41



Boston Scientific	0%
Biotronik	0%
Medtronic	2%
St. Jude	97%
Unknown	0%

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Key Concept

- A good quality CXR will help you:
 - Determine if the patient has an ICD or a pacer
 - Determine the ICD manufacturer

43

Why do I care so much about the ICD Manufacturer?

- Must use a company specific programmer to interrogate the ICD
- ICD's magnet response depends on the manufacturer

44

Magnets and ICDs

- You should know how a magnet will affect any type of ICD

45

Three General Concepts

1. A magnet will inhibit the anti-tachy therapy (ATT) of essentially all ICDs for as long as the magnet is on the ICD
2. Magnets will practically never affect the ICD's pacing component
3. Two ICD brands will emit a tone when a magnet is applied, the other three will not

46

ICD—Magnet Summary

Manufacturer	Response to Magnet	Effect on Pacer component of ICD	Tone Emitted?	*Can ICD be programmed to ignore magnet?	Miscellaneous
Boston Scientific	ICD inhibited until magnet removed*	None	Yes, persistent R-wave synchronous beeping tone Standard—continual Sub Q ICD—60 seconds	Yes (Very rare)	ICDs that could be permanently deactivated with a magnet are essentially extinct. MRIs disable the beeping tone
Medtronic	ICD inhibited until magnet removed	None	Yes, for 10-15 seconds Monotone-Normal High-Low=Malfunction	No	
St Jude/Abbott	ICD inhibited until magnet removed*	None	No	Yes (Very rare)	
Biotronik	ICD inhibited until magnet removed	None	No	No	Magnet will inhibit ICD for 8 hours only. Would have to remove and replace magnet to extend inhibition
Sorin/Liva Nova	ICD inhibited until magnet removed	Converts pacer rate to 96-80 depending on battery life. Pacing mode unchanged	No	No	No option to convert to an asynchronous pacing mode even when the ICD is inhibited with a programmer

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ICD—Magnet Summary

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Boston Scientific ICD



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Boston Scientific S-ICD

2. LISTEN FOR BEEPING TONES
If the magnet is correctly placed over the device, beeping tones (r-wave synchronous) will be heard approximately one second after the magnet is applied. Arrhythmia detection is now suspended and shock therapy is inhibited.

When using the magnet for a patient with a deep implant placement, the exact location of the pulse generator may not be evident, and other magnet positions may need to be tested near the general pulse generator location. Considering the following tips when attempting to apply the magnet:

- Beeping may be difficult to hear and a stethoscope should be used if necessary.
- Two or more magnets may be used in a stacked configuration to increase the likelihood of eliciting beeping tones and associated inhibition of therapy.
- If beeping tones cannot be detected, it may be necessary to use the programmer to suspend therapy in these patients.

WARNING: In patients with a deep implant placement (greater distance between the magnet and the pulse generator) magnet application may fail to elicit the magnet response. In this case the magnet cannot be used to inhibit therapy.

3. HOLD THE MAGNET IN PLACE
Therapy remains inhibited for as long as the magnet remains correctly positioned. While the magnet is held correctly in place, r-wave synchronous beeping tones will continue for 60 seconds. After 60 seconds, the beeping stops, but therapy continues to be inhibited unless the magnet has been moved.

NOTE: If it is necessary to reconfirm that therapy is still being inhibited after beeping has stopped, remove and replace the magnet to reactivate the beeping tones. This step can be repeated as necessary. When long duration therapy suspension is desired, it is recommended to modify pulse generator behavior with the programmer rather than the magnet.

4. REMOVE THE MAGNET
When the magnet is removed, arrhythmia detection resumes and therapy delivery is no longer inhibited.

IMPORTANT: If the beeping tones do not stop upon magnet removal, please call Technical Services for additional guidance.

https://www.bostonscientific.com/content/dam/bostonscientific/quality/education/resources/english/US_ACL_SICD_Magnet_Use_20150413.pdf



53

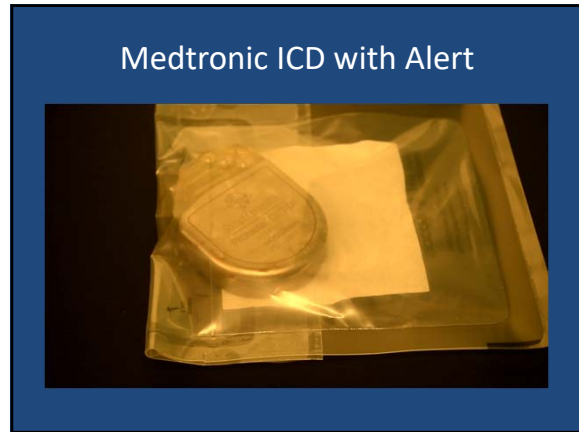
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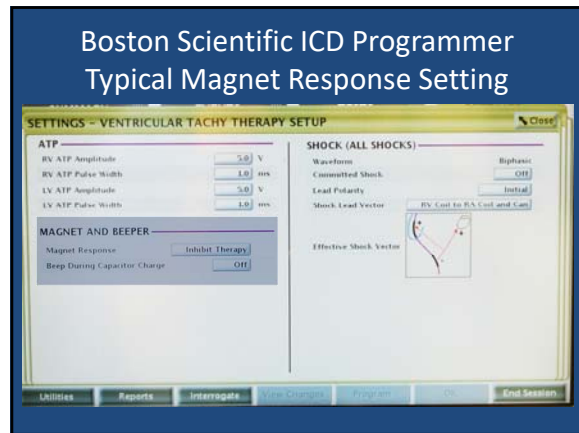


56

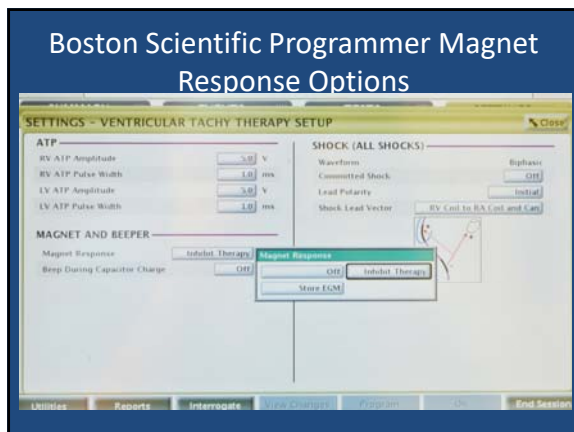
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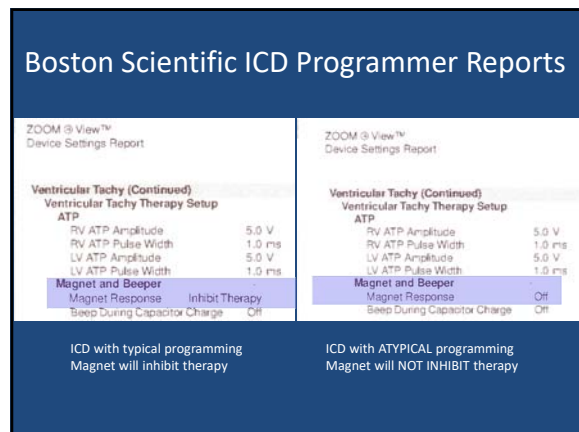
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Boston Scientific ICD Magnet Response

- If you hear a beeping tone when you apply a magnet, the ICD is programmed to respond to the magnet
- If you do not hear a tone, use a programmer to determine for certain how the ICD will respond to a magnet

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St Jude ICD Magnet Response: Normal

The screenshot shows the 'Basic Operation' menu of the St Jude ICD programmer. The 'Magnet Response' is set to 'Normal'. Other settings include Mode: DDDR, Ventricle Pacing: Simul, V. Triggering: OFF, V. Noise Reversion Mode: Pacing OFF, and Epistodal Pacing Mode: DDI.

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St Jude ICD Magnet Response: Ignore

Two side-by-side screenshots of the St Jude ICD programmer interface. The left screenshot shows 'Magnet Response' set to 'Normal', and the right screenshot shows it set to 'Ignore'. The 'Ignore' setting is highlighted with a red box in the right screenshot.

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Abbott/St Jude ICD Programmer Report

Parameters			Parameters		
Patient	Date of Birth	Indications for I	Patient	Date of Birth	Indications for I
EF %	Jul 26, 1937	Unknown	EF %	Feb 26, 1948	35 %
Device	Manufacturer	Model	Device	Manufacturer	Model
ICD	St. Jude Medical	Forty Assura™	CRT-D	St. Jude Medical	Unity™ 3231-45
A Lead	St. Jude Medical	Tendin® STS 20	A Lead	St. Jude Medical	Tendin® ST Opti
V Lead	St. Jude Medical	Durata® 7121Q	RV Lead	St. Jude Medical	Ruate® ST Opti
			LV Lead	St. Jude Medical	QuickSee® 1056
Basic Operation			Basic Operation		
Mode	DDDR		Mode	DDDR	
Magnet Response	Normal		Magnet Response	Ignore	
V. Noise Reversion Mode	Pacing OFF		V. Noise Reversion Mode	DDI	
Epistodal Pacing Mode	DDI		Epistodal Pacing Mode	DDI	
Sensor	On		Sensor	On	
Threshold (Measured Avg.)	Auto (+0.0) (2.0)		Threshold (Measured Avg.)	Auto (+0.0) (2.0)	
Slope	B		Slope	B	
Max Sensor Rate	100 bpm		Max Sensor Rate	110 bpm	
Reaction Time	Fast		Reaction Time	Fast	
Recovery Time	Medium		Recovery Time	Medium	

You can also determine the magnet response setting by reading the programmer report

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St Jude ICD and Magnet

- To absolutely confirm that a magnet will inhibit the Abbott/St Jude ICD, assess the magnet setting with a programmer

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ICD—Magnet Summary

Manufacturer	Response to Magnet	Effect on Pacer component of ICD	Tone Emitted?	*Can ICD be programmed to ignore magnet?	Miscellaneous
Boston Scientific	ICD inhibited until magnet removed*	None	Yes, persistent R-wave synchronous beeping tone Standard—continuous Sub Q ICD—50 seconds	Yes (Very rare)	ICDs that could be permanently deactivated with a magnet are essentially extinct. MRIs disable the beeping tone
Medtronic	ICD inhibited until magnet removed	None	Yes, for 10-15 seconds Monotone-Normal High-Low-Malfunction	No	
St Jude/Abbott	ICD inhibited until magnet removed*	None	No	Yes (Very rare)	
Biotronik	ICD inhibited until magnet removed	None	No	No	Magnet will inhibit ICD for 8 hours only. Would have to remove and replace magnet to extend inhibition

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What about the Boston Scientific ICDs that could be permanently reprogrammed OFF with a magnet?

Table 1 Guidant/Boston Scientific implantable cardioverter defibrillator models with and without the 'change tachy mode with magnet' feature*	
Devices with the 'change tachy mode with magnet' feature	PRIZM® 1 - 1850, 1851, 1852, 1853, 1857, 1858 PRIZM® 2 - 1860, 1861 VITALITY® 1 - T125, T127, T135 VITALITY® 2 - T165, T167, T175, T177, T180, A135, A155 CONFIDENT® - E030 TEUGEN® - E110 EMANI® - H220, H221 (LV-1), H222, H229 (LV-1) COGNIS® - N118 (LV-1), N119 CONTAQ® RENEWAL 1 - H135 CONTAQ® RENEWAL 2 & 4 - H170, H175 (LV-1), H177, H179 (LV-1) CONTAQ® RENEWAL 3R - H210, H215 (LV-1), H217, H219 (LV-1)
Devices without the 'change tachy mode with magnet' feature	
Devices with a 'software patch' to inactivate the 'change tachy mode with magnet' feature	

Take Home Message—the Prizm, Vitality, and Contaq ICDs are all but extinct. You should not worry about permanently deactivating a Boston Scientific ICD with a magnet any longer

Jacob S, et al; Europace (2011) 13:1222-1230

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ICD—Magnet Summary

Manufacturer	Response to Magnet	Effect on Pacer component of ICD	Tone Emitted?	*Can ICD be programmed to ignore magnet?	Miscellaneous
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Biotronik	ICD inhibited until magnet removed	None	No	No	Magnet will inhibit ICD for 8 hours only. Would have to remove and replace magnet to extend inhibition

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MRIs Disable the Beeping Tone in Boston Scientific ICDs

- An MRI can destroy the ICD's speaker
- The expected beeping tone will not be audible even though the anti-tachy therapy is being inhibited

My Alerts

19 Sep 2019 12:18 → Beeper is disabled due to MRI Protection Mode usage.

Events Since Last Reset (04 Sep 2019)

22 Sep 2020 12:15 RYTHMIQ at 48 bpm

22 Sep 2020 11:40 RYTHMIQ at 48 bpm

See last page for full list of Events Since Last Reset.

Battery OK

Approximate time to explant: 10 years

Charge Time 10.5 s

Last Capacitor Re-form 30 Jul 2020 13:01 One Year Remaining

Explant


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ICD—Magnet Summary


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How to Position a Magnet



Medtronic
Boston Scientific
Biotronik



Abbott/St Jude






Bost Scientific Emblem
S-ICD

Jacob S, et al; Europace (2011) 13:1222-1230--modified

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Helpful Tips for Using a Magnet to Inhibit an ICD in the OR:

- Define border of the ICD with marking pen
- Secure Magnet with tape or tegaderm
- Check the magnet position often
- Confirm position with stethoscope for Bos Sci ICDs

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Quiz Question

- In the OR, you place a magnet on a Boston Scientific ICD and do not hear a tone, which of the following could be true:
 - a. Anti-tachy therapy has already been suspended with a programmer
 - b. The ICD has been programmed to ignore a magnet
 - c. The ICD has been exposed to an MRI
 - d. All of the above**

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Match the Following ICDs with their Expected Magnet Response

Continual beeping	→	Normal Medtronic
Monotone for 15 sec	→	Boston Scientific ICD
High-Low for 15 sec	→	Bost Sci S-ICD
Beeping for 60 sec	→	Abnl Medtronic

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Key Concepts

- Magnets appropriately applied to ICDs will almost always inhibit the anti-tachy therapy, but will not affect the ICD's pacer component
- An emitted tone can help identify Boston Scientific and Medtronic ICDs

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Two Publications That Can Guide Your Management

1. HRS/ASA Expert Consensus Statement 2011
2. ASA Practice Advisory Update 2020

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HRS/ASA Consensus Statement 2011

The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the Perioperative Management of Patients with Implantable Defibrillators, Pacemakers and Arrhythmia Monitors: Facilities and Patient Management

This document was developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS)

George H. Crossley, MD, FHRS,¹ Jeanne E. Poole, MD, FHRS,² Marc A. Rozner, PhD, MD,^{3,4} Samuel J. Asirvatham, MD, FHRS,⁵ Alan Cheng, MD, FHRS,⁶ Mina K. Chung, MD, FHRS,⁷ T. Bruce Ferguson, Jr., MD,^{7,8} John D. Gallagher, MD,⁹ Michael R. Gold, MD, PhD, FHRS,¹⁰ Robert H. Hays, MD,¹⁰ Samuel Inefkin, MD,¹¹ Fred M. Kusumoto, MD, FHRS,¹² Liza Prudente Moorman, MSN, ACNP, FHRS,¹³ Annemarie Thompson, MD¹⁴

- Excellent review of perioperative electrophysiology
- Provides guidance for all types of procedures
- Cardiology perspective

Heart Rhythm July 2011; 1114-1154

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ASA Practice Advisory 2020

PRACTICE PARAMETERS

Practice Advisory for the Perioperative Management of Patients with Cardiac Implantable Electronic Devices: Pacemakers and Implantable Cardioverter-Defibrillators 2020

*An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Implantable Electronic Devices**

- Excellent background information
- Perioperative guidance for all types of procedures
- Excellent MRI section
- Anesthesia perspective

Anesthesiology 2020;132:225-52

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ASA Practice Advisory 2020

- Read Appendix 1 for brief summary
- Read the footnotes

Appendix 1: Summary of Advisory Recommendations

Preoperative Evaluation


- Determine whether a patient has a cardiac implantable electronic device (CIED)
- Conduct a focused history (e.g., interview the patient or other sources, review medical record, chest x-rays, and electrocardiogram if available)
- Perform a focused physical examination (e.g., check for scars, pulse for device)
- Determine the cardiac implantable electronic device type, manufacturer, and primary indication for placement
- Obtain the manufacturer's identification card from the patient or other source
- Review the medical record
- Obtain and review the most recent cardiac implantable electronic device interrogation report
- Refer to supplemental resources (e.g., manufacturer's database, cardiac implantable electronic device clinic records)
- Order a chest x-ray if no other data are available
- Determine whether the patient is pacing dependent
- From the focused history and medical record, assess for one or more of the following indications:
 - Bradycardia that caused syncope or other symptoms resulting in cardiac implantable electronic device implantation
 - Successful preoperative medical dilation resulting in cardiac implantable electronic device implantation
 - A cardiac implantable electronic device interrogation
- Determine the cardiac implantable electronic device's current settings, that it is functioning properly (e.g., by interrogating the cardiac implantable electronic device or obtaining the most recent interrogation report), and that it is optimally programmed for the planned procedure
- Reinterrogate the cardiac implantable electronic device if there is any question of proper function

Preoperative Preparation

- Determine whether intraoperative electromagnetic interference is likely to occur
- If electromagnetic interference is likely to occur (e.g., monopolar electrocautery [“bow”] use, or radiofrequency ablation is planned superior to the umbilicus), alter the pacing function of a cardiac implantable electronic device to an asynchronous pacing mode in the pacing-dependent patient and suspend an implantable cardioverter-defibrillator's antitachycardia function, if present
- Before suspending the antitachycardia function, ensure that the patient is in a monitored environment

101

Perioperative Management of Patients with an ICD



Three Phases:

1. Preoperative
2. Intraoperative
3. Postoperative

102

Preoperative Management

1. Preoperative assessment of the ICD
2. Surgical considerations
3. Do you need to suspend the anti-tachy therapy?

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Preoperative Management

1. Preoperative assessment of the device
 - Most recent ICD interrogation should be within 6 months
 - The best prescription for perioperative management is for the EP team to communicate pertinent device information to the OR team

2011 HRS/ASA Guidelines

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Essential Information for OR Team

Table 3 Essential elements of the preoperative CIED evaluation to be provided to the operative team

- Date of last device interrogation
- Type of device—pacemaker, ICD, CRT-D, CRT-P, IIL, implantable hemodynamic monitor
- Manufacturer and model
- Indication for device:
 - Pacemaker: e.g., sick sinus syndrome, AV block, syncope
 - ICD: primary or secondary prevention
 - Cardiac resynchronization therapy
- Battery longevity documented as >3 months
- Are any of the leads less than 3 months old?
- Programming
 - Pacing mode and programmed lower rate
 - ICD therapy
 - Lowest heart rate for shock delivery
 - Lowest heart rate for ATP delivery
 - Rate-responsive sensor type, if programmed on
- Is the patient pacemaker dependent, and what is the underlying rhythm and heart rate if it can be determined?
- What is the response of this device to magnet placement?
 - Magnet pacing rate for a PM
 - Pacing amplitude response to magnet function
 - Will ICD detectors resume automatically with removal of the magnet? Does this device allow for magnet application function to be disabled? If so, document programming of patient's device for this feature
- Any alert status on CIED generator or lead
- Last pacing threshold—document adequate safety margin with the date of that threshold

Heart Rhythm July 2011; 1126

- Type of device
- Manufacturer
- Location of device
- Last interrogation
- Battery and lead status
- Current settings
- Pacing dependence
- Magnet response for SJM and BSc ICDs

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Preoperative Management

2. Surgical Considerations
 - Surgical site
 - Intended cautery use
 - Patient position
 - Surgical duration

Need to assess EMI risk / applicability of magnet use

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Preoperative Management

3. Do you need to disable the anti-tachy therapy?

This question has several possible answers:

1. HRS/ASA Guideline recommendations
2. ASA Practice Advisory recommendations
3. Recent published evidence
4. My opinion

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When Does the ICD Anti-tachy Therapy Need to be Turned Off?

- Key Statements from the HRS/ASA Guidelines:
 - Surgery above the umbilicus:
 - Inhibit ICD
 - Surgery below the umbilicus:
 - “Oversensing in an ICD patient is unlikely when monopolar electrosurgery is applied below the umbilicus”
 - “May be unnecessary to inhibit an ICD with a magnet or programmer, but it is a reasonable alternative to no intervention”
 - Surgery on lower extremities:
 - “The risk of false arrhythmia detection is considered so low for surgical procedures on the lower extremities that neither re-programming nor magnet application is mandatory”

2011 HRS/ASA Guidelines

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When Does the ICD Anti-tachy Therapy Need to be Turned Off?

- Key Statements from the 2020 ASA Practice Advisory

Preoperative Preparation

- Determine whether intraoperative electromagnetic interference is likely to occur.
- If electromagnetic interference is likely to occur (e.g., monopolar electrosurgery [“bovie”] use, or radiofrequency ablation is planned superior to the umbilicus), alter the pacing function of a cardiac implantable electronic device to an asynchronous pacing mode in the pacing-dependent patient^{*****} and suspend an implantable cardioverter–defibrillator’s antitachycardia function, if present^{*****}

Because this is a murky issue, the Practice Parameter is relatively conservative with recommendations—there is nothing specific other than this statement

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ICD Cautery Study 2017

- Friedman et al at Mayo Clinic
- 103 patients having non-cardiac surgery
- ICDs programmed to detect only
- Bovie return pad on thigh or buttock

J Interv Card Electrophysiol (2017) 48:21-26

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Brief Study Results Summary

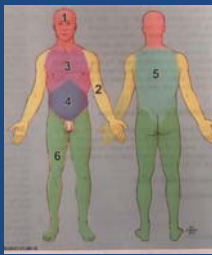
- 11 patients had bipolar cautery—no issue
- 92 patients had monopolar cautery
 - 11 had EMI detected

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Results

Surgical areas	Number	ICD detection, n (%)
Head, neck	7	3 (43)
Shoulder/upper extremity	23	2 (9)
Thoracic (non-cardiac surgery)	10	5 (50)
Abdomen, pelvic	34	1 (3)
Back, spine	3	0 (0)
Hip, lower extremity	24	0 (0)
Total	103	11 (11)

Dispersive grounding pad applied to lower extremities in all cases



This study supports the HRS recommendation that it is acceptable to leave ICDs on during Hip/lower extremity surgery.

J Interv Card Electrophysiol (2017) 48:21-26

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ICD-Cautery Study 2019

ANESTHESIOLOGY

Electromagnetic Interference with Protocolized Electrocautery Dispersive Electrode Positioning in Patients with Implantable Cardioverter Defibrillators

Peter M. Schulman, M.D., Miriam M. Treggiari, M.D., Ph.D., M.P.H., N. David Yarnal, Ph.D., Charles A. Henricsson, M.D., Peter M. Jassal, M.D., Thomas A. Devland, M.D., Myriam J. Kherani, M.D., Ph.D., Valerie Sears, M.D., Izumi Harakuni, M.D., Ryan B. Anderson, M.D., Ph.D., Ed Kant, M.D., Jon Benjamin, M.D., Nabil Akayev, M.D., Ph.D., Eric C. Stocker, M.D., M.P.H.

Anesthesiology 2019; 130:530-40

- Analyzed 144 patients with ICDs who were having surgeries in various parts of the body
- Determined what the ICDs were “seeing” during the surgery

Schulman et al, Anesthesiology April 2019

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Schulman et al.¹ analyzed effects of surgical electromagnetic interference (EMI) on 144 ICD patients.

Monopolar cautery + **ON ICD** + Protocol for dispersive pad placement

Rate response, anti-tach therapy OFF

70 above the umbilicus
20% of patients had EMI detected
7% of patients had clinically meaningful EMI

40 below the umbilicus
2.5% of patients had EMI detected
0% of patients had clinically meaningful EMI

34 cardiac surgeries
68% of patients had EMI detected
29% of patients had clinically meaningful EMI

*causing pacing inhibition or inappropriate anti-tach therapy

Schulman et al, Anesthesiology April 2019; Infographic: J Wanderer

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Fig. 1. Statistics of the protocolized position of electrocautery and dispersive electrode placement. See also table 1.

Schulman et al, Anesthesiology April 2019

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Schulman et al.¹ analyzed effects of surgical electromagnetic interference (EMI) on 144 ICD patients ...

Monopolar cautery + **ON ICD** + Protocol for dispersive pad placement

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34 cardiac surgeries
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Appropriate anti-tach therapy

This paper supports the HRS/ASA recommendation, assuming appropriate bovie return pad placement

Schulman et al, Anesthesiology April 2019; Infographic: J Wanderer

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Key Summary Concepts

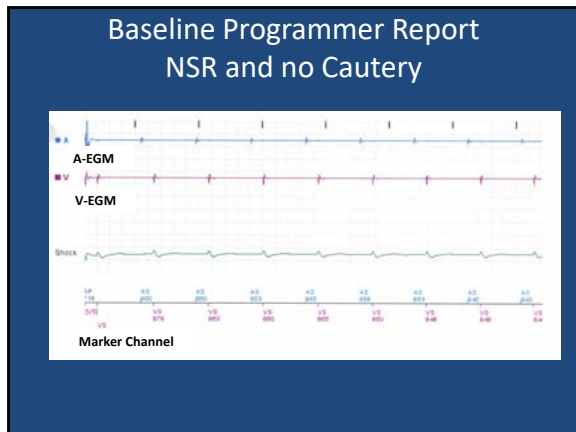
- If the surgeon will use monopolar electrocautery above the umbilicus, SUSPEND anti-tachy therapy
- If the surgery is below the umbilicus, the HRS Paper provides support and Schulman’s study provides evidence that you could leave the ICD ON, assuming appropriate return pad placement
- If the surgery is on the lower extremity, All four papers support leaving ICDs ON, assuming appropriate return pad placement

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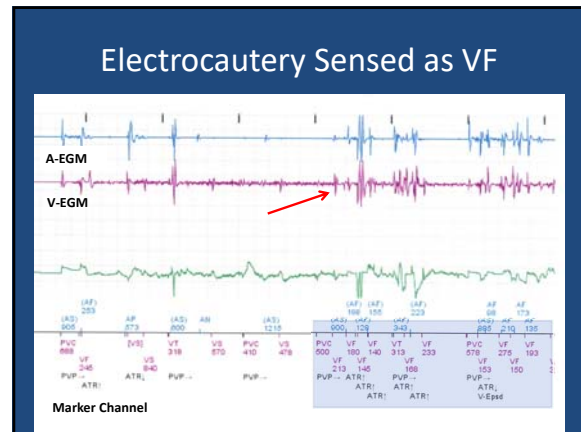
Hip Surgery and ICD

- 76 yo F having R hip surgery with GA
- Has Boston Scient ICD
- 5’2” 55 kg

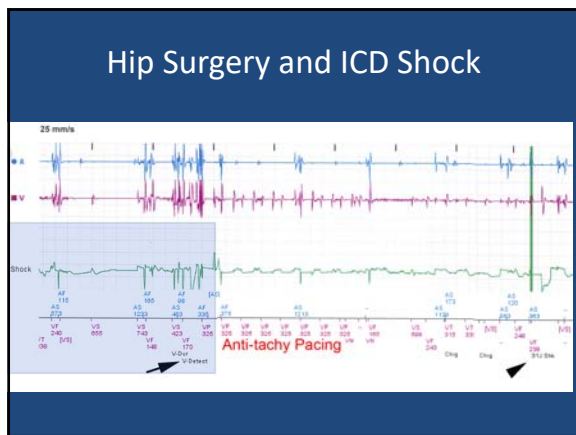
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Hip Surgery and ICD

- Anesthesia team not aware of the shock
- Detected in post op assessment of ICD
- Why did the patient get the shock?
 - Small stature?
 - Bovie return pad placement?

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Hip Surgery and ICD Op Report

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ELECTROSURGICAL - RISK FOR INJURY/POTENTIAL IMPAIRMENT
Electrosurgical Units 1: Y
Cut:40          Coag:40
Pad Site: upper back
Electrosurgical Units 2: N
Bipolar Coagulator: N
Harmonic Scalpel: N
Argon Beam: N
    
```

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Key Concept

- Pay attention to bovie return pad placement
 - OR nurses may need guidance

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Lower Extremity Surgery

- Is there a risk of the patient getting a shock even if the cautery return pad is placed appropriately?

133

APSF NEWSLETTER June 2017 PAGE 10

C&A

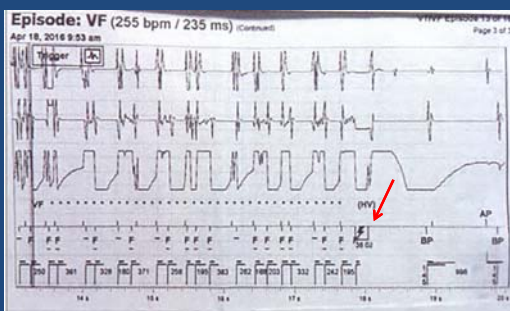
Unintended Discharge of an ICD in a Patient Undergoing Total Knee Replacement

- 82 yo M for R Total Knee Replacement
- 5'6" 146 lbs
- Spinal anesthesia and sedation
- Cautery return pad placed on contralateral leg
- Anesthesia team acted in accordance with HRS paper and did not inhibit ICD

Kleinman B, et al APSF Newsletter June 2017

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Intraop Shock



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Seven Aborted Charges and one ATP

VF/VF Episodes	Type	Rate (bpm)	Duration (M S)	Therapy Delivered	Alerts
Apr 18, 2016 10:00 am	VF	342	00:09		⊠x2
Apr 18, 2016 9:57 am	Non-sustained		00:06		⊠x1
Apr 18, 2016 9:53 am	VF	315	00:11		⊠x2
Apr 18, 2016 9:53 am	VF	255	00:13	36J	⊠x1
Apr 18, 2016 9:47 am	Non-sustained		00:08		⊠x3
Apr 18, 2016 9:47 am	VF	444	00:21		⊠x2
Apr 18, 2016 9:36 am	VF	307	00:09		⊠x1
Apr 18, 2016 9:27 am	Non-sustained		00:16		⊠x2
Apr 18, 2016 9:17 am	VF	268	00:13	ATP	⊠x1
Apr 18, 2016 9:13 am	VF	210	00:14		⊠x1
Apr 18, 2016 9:07 am	Non-sustained		00:08		

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Key Concepts

- It appears unlikely that an ICD will shock a patient having lower extremity surgery if the bowie return pad is placed appropriately and the ICD's settings are typical, but the incidence is not zero.
- You will have to decide if you are comfortable with leaving the ICD's anti-tachy therapy on or not.

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Under Body Dispersive Pad

- **WARNING**—Avoid this if your patient has an ICD

MEGADYNE™ MEGA SOFT™ Reusable Patient Return Electrode positioning

Electromagnetic Interference With an Underbody Dispersive Electrode in a Patient With an Implantable Cardioverter-Defibrillator Undergoing Noncardiac Surgery: A Case Report

Tully, Brian W. 2021. Seminars in Anesthesia, Perioperative Medicine, and Intensive Care, Volume 11, Issue 11, p 447-451. doi:10.1097/SAN.0000000000000011

Ethicon Website; Megadyne system
Tully et al A&A Practice Sept 24, 2020

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Reprogramming vs Magnets

- If you decide that the ICD anti-tachycardia therapy should be suspended, you must decide if you will reprogram the ICD or use a magnet to suspend therapy

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Reprogramming the ICD

- 100% reliable
- Is mandatory if you need to change the pacing mode or rate
- More time consuming—need someone who can use the programmer
- Risks:
 - Pt develops unrecognized VT/VF or care team unable to use the backup defib equipment
 - **Sending patient home with ICD off**

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Magnet

- Less time consuming—any anesthesiologist can use it
- If pt develops dysrhythmia, can remove magnet
- No risk of discharging patient home with ICD off

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Do Magnets reliably inhibit the ICD?

Answer: Not Always

This is particularly the case in patients in the lateral or prone position, pts with obesity, and pts with the surgical site close to the ICD

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Thoracic Procedure

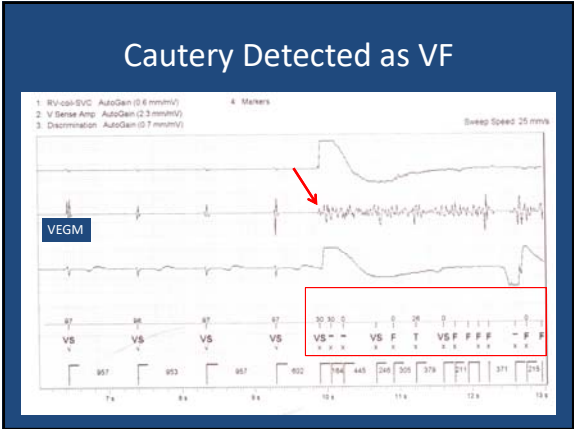
- Pt booked for a VATS procedure
- CAD
- Patient has an ICD

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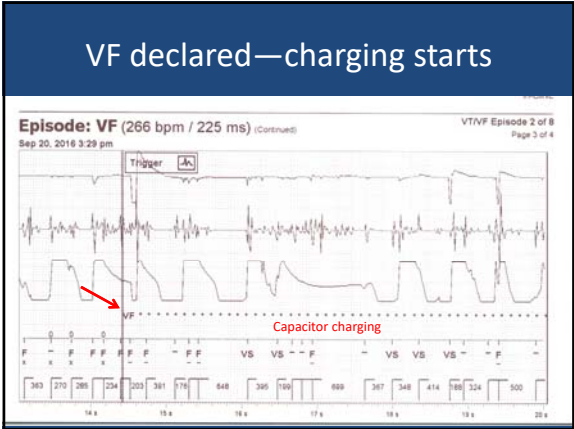
Intraop Course

- Pt placed in lateral position
- Magnet placed over the ICD securely
- Position checked intermittently

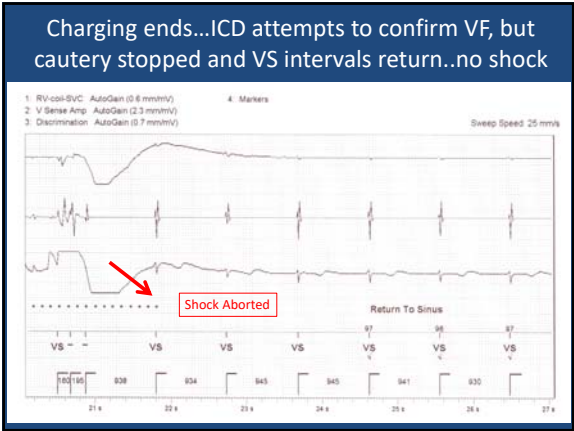
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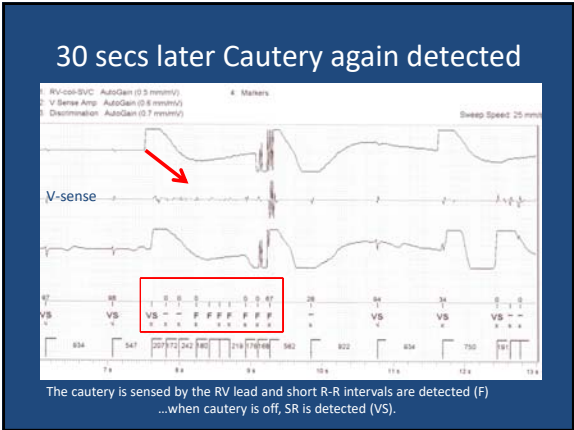


148

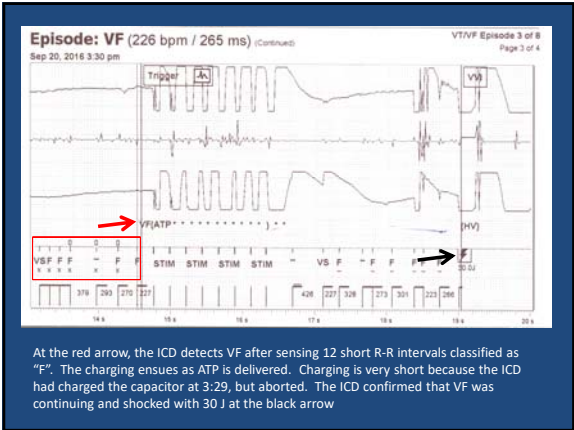
Is the Aborted Shock Benign?

- The ICD charging diminishes battery life even when the charge is not delivered.
- A full charge consumes approximately 30 days of the ICD's battery life

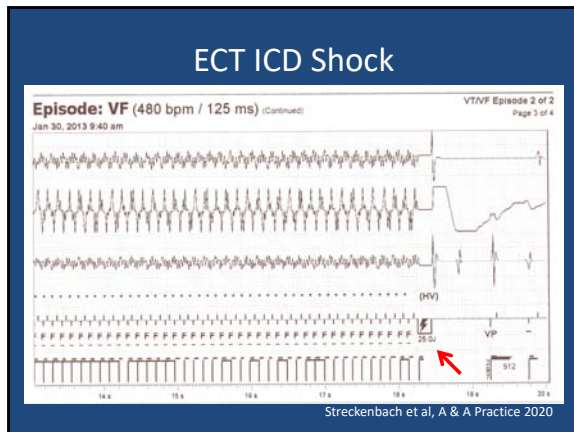
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Using Magnets near the Surgical Field: Thyroid Surgery and ICD Shocks

- Patient had Biotronic ICD and a magnet was used to inhibit the tachy therapy
- Patient received 2 shocks

Recordings - Episodes							
No.	Time	Zone	PP [ms]	RR [ms]	Description	PP [ms]	RR [ms]
90		VF	589	164	1 Shock	***	***
89		VF	219	147		965	973
88		VF	690	171	1 Shock	***	***
87		---	604	604	Periodic IEGM	***	***
86		ATR	180	779		690	696

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Magnets are not so Reliable!

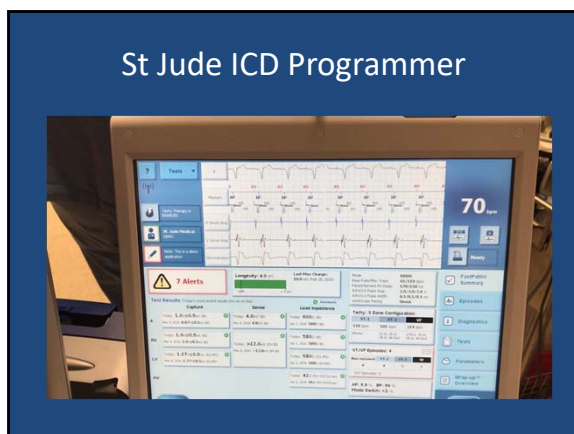
- During none of these cases did the anesthetists know the shocks had occurred.
- I suspect this happens more often than we would like to think

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Programmers

- I recommend that several staff in your group learn how to use the programmers, even if only well enough to be able to turn off the ICD anti-tachy therapy (ATT)
- For three manufacturers' devices, turning off the ATT is usually relatively simple

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When is Programming More Complex?

- If you need to disable the anti-tachy therapy of a Medtronic ICD
- If you need inhibit anti-tachy therapy for any device AND convert the pacing mode to asynchronous

See PEPT.org for demonstration videos

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Medtronic ICD



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If you decide to use a Programmer to turn off the ATT you...

- Need the company specific programmer

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Boston Scientific S-ICD Programmer

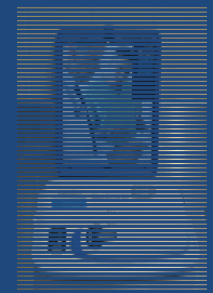


Boston Scientific purchased this ICD from Cameron Health

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Medtronic Tablet Programmer

- The Cobalt ICDs require the Tablet Programmer—they are not programmable with the standard Medtronic programmer



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If you decide to use a Programmer to turn off the ATT you...

- Need the company specific programmer
- You will become the patient's ICD
 - Patient must be closely monitored
 - Must place extern defib pads
- Cannot forget to reprogram the ICD post op

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How Do I Manage ICDs in the OR?

- No Cautery:
 - Leave ICD on
- Bipolar cautery:
 - Only disable ICD if surgery is very close to the RV sensing lead
- Monopolar cautery:
 - Disable ICD's anti-tachy therapy unless cautery limited to the foot

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Suspend Anti-Tachy Therapy with a Programmer

Use a Programmer if:

1. Not sure how the ICD will respond to a magnet
2. The patient will need pacemaker reprogramming
3. The patient will be prone or lateral
4. Surgery will involve the chest, upper arm, shoulder, neck, or intracranial structure or any other surgery preventing easy access to the ICD
5. The ICD is not easy to palpate due to conditions such as obesity or recent device implant
6. The procedure is so long that a magnet could cause tissue necrosis

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Suspend Anti-Tachy Therapy with a Magnet

Using a magnet reasonable if:

1. Pt will be supine and there will be easy access to the ICD throughout the procedure (see figure below)
 - a. Procedure is below the xiphoid or below the elbows
2. The ICD is easy to palpate (patient not obese)
3. You know how the ICD will respond to the magnet
4. No change in the pacing mode or rate will be needed
5. You have no easy access to a programmer



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Where do I turn off an ICD with a programmer?

- Preferably not in the Preop Area
- Preferably when the patient is in the actual operating room, fully monitored with backup defibrillation equipment in place

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My Definition of having backup Defibrillation Capability

1. Pt fully monitored
2. Ext Defib pads on patient and connected to the Ext Defibrillator
3. User knowledge confirmed



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Intraop Management Considerations

- Ensure continued cardiac monitoring and backup defibrillation/pacing at all times
- If using a magnet, check its position often
- Watch for inappropriate shocks, ATP, or pacemaker function related to EMI
 - Asystole
 - Inappropriate pacing (tracking the cautery)

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Intraop Management Considerations

- If you used a magnet to inhibit the ICD (assuming you placed external defib. pads), what will you do if the patient develops VF?
 - Remove magnet and let ICD do the shock?
 - Shock the patient with Ext. Defib Pads?

My answer: Shock the patient with Ext Defib Pads

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Postop Management Considerations

- Does the Patient Need Interrogation?
- There are three scenarios to consider:
 1. Prior to D/C from a monitored setting
 2. Within 1 month of D/C from hospital
 3. Routine follow up only

Source: HRS/ASA Consensus Statement

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Postoperative Management

1. EP evaluation prior to DC from monitored setting:
 1. The ICD or pacer was reprogrammed preop
 2. Pt underwent cardiac, thoracic, open vasc, etc. proc.
 3. Pt had cardiac arrest, CV, CPR, temp pacing etc
 4. Pt had emerg surgery above umbilicus
 5. Pt had RFA or Ther Rad.
 6. Shock or unexpected movement noted
 7. Abnl tones emitted or apparent pacer dysfunction
 8. PA catheter inserted in patient with leads < 3 mos old

Source: HRS/ASA Consensus Statement

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Postoperative Management

2. Interrogation within 1 month of D/C from hospital
 - If cautery or lithotripsy were used, but the patient does not meet any of the 8 previous criteria, the patient's device should be interrogated within 1 month of DC by the cardiologist
 - In the office or remotely

Source: HRS/ASA Consensus Statement

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Postoperative Management

3. Routine EP follow-up only
 - If no cautery or lithotripsy were used, no additional EP evaluation is needed...
 - Patients should see their EP care team as scheduled

Source: HRS/ASA Consensus Statement

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Which Patients Need "Immediate" Post Op Interrogations

Table 9 Indications for the interrogation of CIEDs prior to patient discharge or transfer from a cardiac telemetry environment
<ul style="list-style-type: none"> • Patients with CIEDs reprogrammed prior to the procedure that left the device nonfunctional such as disabling tachycardia detection in an ICD. • Patients with CIEDs who underwent hemodynamically challenging surgeries such as cardiac surgery or significant vascular surgery (e.g., abdominal aortic aneurysm repair).* • Patients with CIEDs who experienced significant intraoperative events including cardiac arrest requiring temporary pacing or cardiopulmonary resuscitation and those who required external electrical cardioversion.* • Emergent surgery where the site of EMI exposure was above the umbilicus • Cardio-thoracic surgery • Patients with CIEDs who underwent certain types of procedures (Table 8) that emit EMI with a greater probability of affecting device function. • Patients with CIEDs who have logistical limitations that would prevent reliable device evaluation within one month from their procedure.*

Heart Rhythm July 2011; 1132

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Cautionary Statement

- Not every case fits neatly into the aforementioned post op situations—if there is any question about post-op management, err on the side of safety and contact someone with EP experience

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Final Review

1. It takes 3-4 secs of cautery to fool an ICD into believing a patient is in VF
2. Inappropriate shocks are bad, and even aborted charges deplete the battery
3. Magnets inhibit an ICD's anti-tachy therapy
4. Magnets do not affect an ICD's pacemaker function
5. The CXR can help you determine what device your patient has
6. And so can a Magnet—use your knowledge of tones and rate change
7. Preop device interrogation should be within 6 months of the surgery
8. Inhibit ATT if surgery includes cautery: consider the 3 zones
9. Pay close attention to the cautery return pad placement
10. Magnets may be unreliable for prone or lateral patients, obese patients, and surgeries close to the ICD
11. Programmers are very useful—consider learning how to use them
12. If you turn off a patient's ICD, you become the patient's ICD

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The End

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Photo courtesy of Drew Streckenbach, Zion NP

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