Perioperative Management of Implantable Cardioverter-Defibrillators

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Massachusetts General Hospital
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I have no conflict of interest

1

My Objective Today:

Increase your knowledge of ICDs and therefore your comfort and competence managing them.

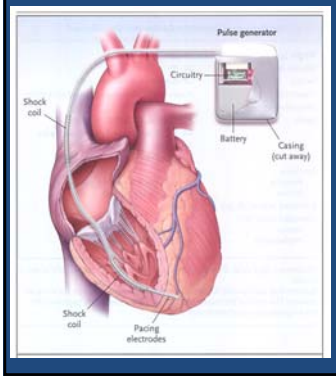
35

What I Will Explain Today

- How do ICDs detect and treat Dysrhythmias
- How to use a Magnet
- How to use the CXR
- Important ICD-Management Publications
- Practical Perioperative ICD Management

36

Transvenous ICDs



1. Defibrillation (40J)
2. Synchronized Cardioversion
3. Anti-tachycardia Pacing (ATP)
4. Standard Pacing
5. Biventricular Pacing

37

Subcutaneous ICD

- Subcutaneous lead
- Delivers high-energy shocks (up to 80 J)
- Does not deliver ATP
- Limited post shock VVI pacing (30 sec)

Boston Scientific S-ICD

39

Extravascular ICD

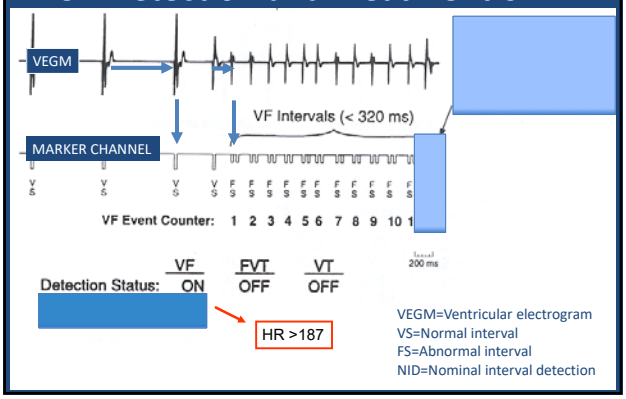
- Intrathoracic lead
- Delivers high energy shocks (40 J)
- Can deliver ATP
- Limited pause-prevention pacing and post-shock pacing

Medtronic Aurora EV-ICD

Friedman et al, NEJM Oct 2022
Tang et al, JCTVA June 2025 (review)

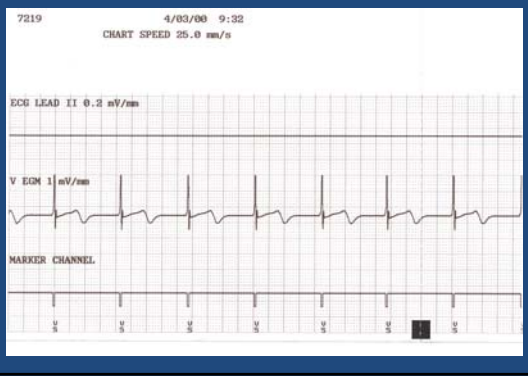
42

ICD Detection and Treatment of VF



68

How does an ICD detect VF?



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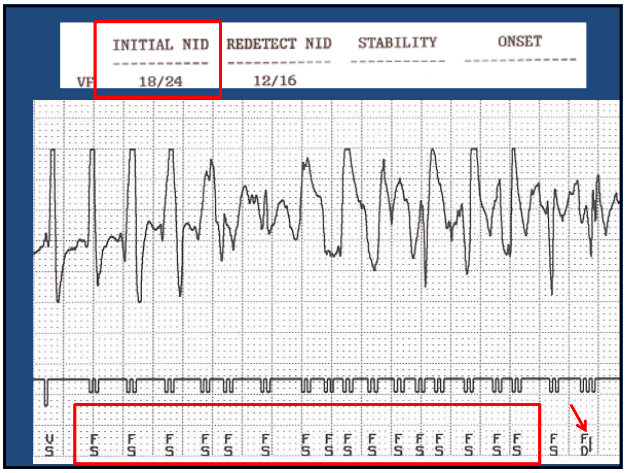
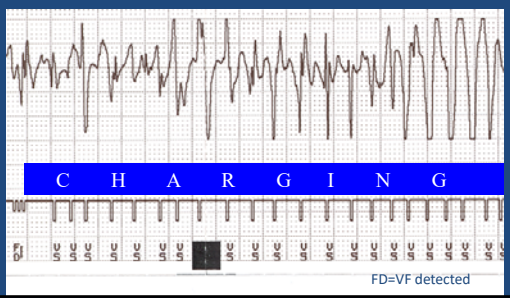


72

Capacitor Charging



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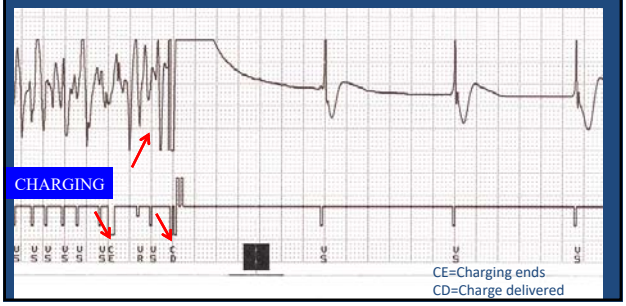
Defibrillation



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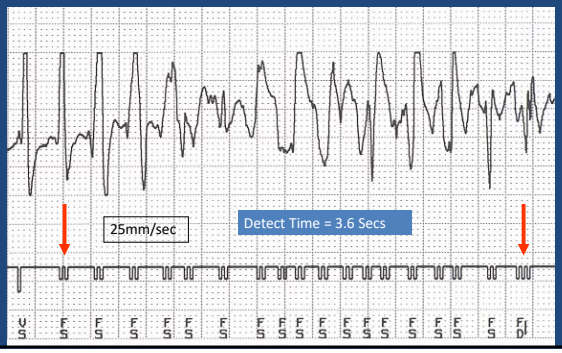
How Long Did it Take to Detect VF?



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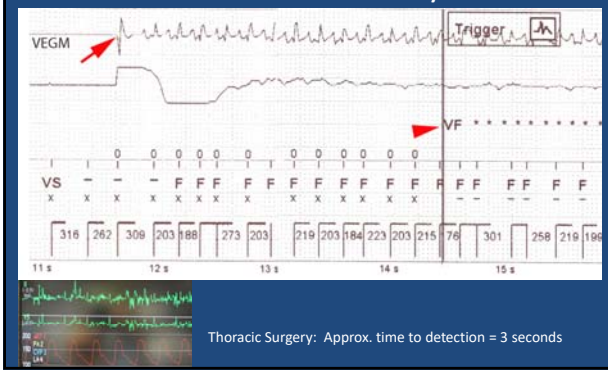
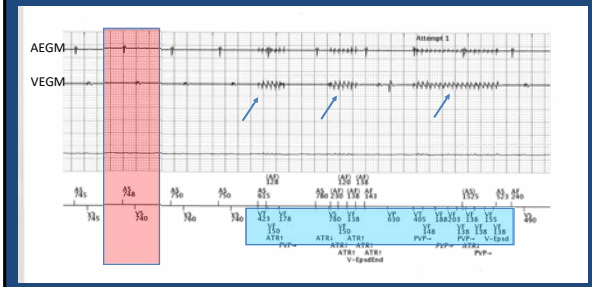
How does an ICD Respond to Continuous Cautery?



Thoracic Surgery: Approx. time to detection = 3 seconds

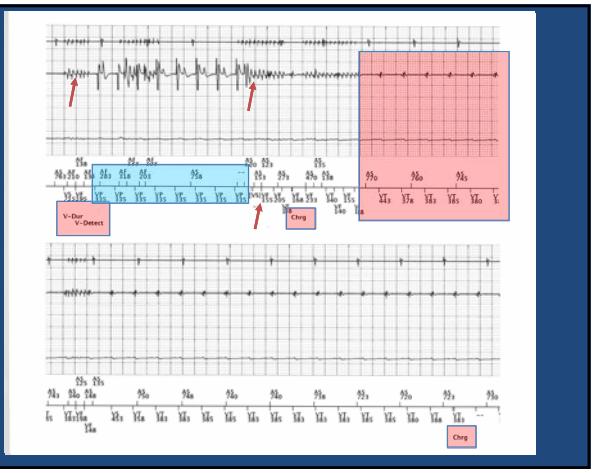
76

Intermittent Cautery can also Trigger Therapy



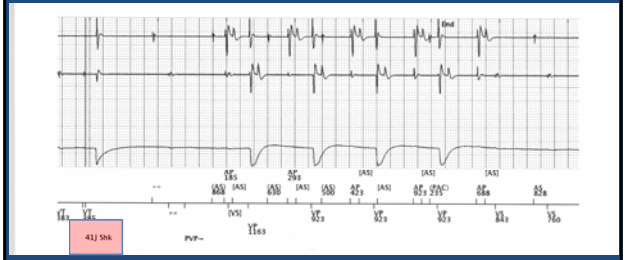
AEGM=Atrial electrogram
VEGM=Ventricular electrogram
AS=Intrinsic atrial activity sensed

78



79

41 J shock delivered



This occurred during an endoscopic procedure—the team did not think the ICD needed to be suspended. They never noticed the shock or the pacing.

81

Key Concepts

- Continuous or intermittent electrocautery can quickly trigger ICD treatment protocols
- Only 2-4 seconds of cautery are needed to trigger therapy
- Therapy can include Synch CV, ATP, and Defibrillation

87

How to Use a Magnet

90

Manufacturer	Can ICD be programmed to ignore a magnet?	Effect on Ant-tachycardia therapy (ATT)	Effect on Pacer component of ICD	Is a Tone Emitted? Assumes ICD is not programmed to ignore the magnet	Miscellaneous Information
Boston Scientific	Yes, for Transvenous devices This option is RARELY utilized	ATT inhibited until magnet removed	None	1. Yes, continual beeping tone as long as magnet on ICD; Sub-Q ICD beeping tone stops after 60 seconds 2. If a monotone is emitted, this indicates the ATT was already suspended with a programmer 3. If no tone is emitted, it could indicate that the speaker function was disabled due to MRI exposure (only affects ICDs made prior to Feb 2022) or that the ICD is programmed to ignore a magnet	"Continual" beeping tone is either R-wave synchronous (Confient, Vitality, Emblem S-ICD, SQ-RX S-ICD) or every second (all other Transvenous ICDs)
Medtronic	No	ATT inhibited until magnet removed	None	1. Yes, for 10 seconds: Monotone=Normal function On-Off=Clinician alert/device issue High-Low=Clinician alert/device issue	The on-off or high-low beeping tone is programmable
St Jude/Abbott	Yes This option is RARELY utilized	ATT inhibited until magnet removed	None	1. Only the newer models (Gallant and Entrant) emit a tone upon magnet placement (4 sec low pitch) and removal (6 sec high pitch)	
Biotronik	No	ATT inhibited until magnet removed or for 8 hrs	None	No	If 8 hrs. elapse, move magnet > 3.25 ft away for 5 minutes
Sorin/Liva Nova/MicroPort	No	ATT inhibited until magnet removed	Rate 96->80 depending on battery life. Pacing mode unchanged	No	

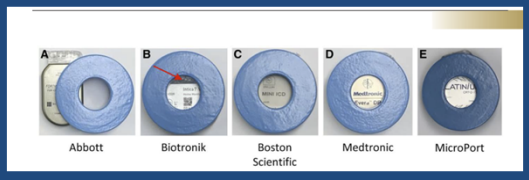
91

Six Things You Should Know to Effectively Use a Magnet

97

1. How should you apply the Magnet?

- Transvenous ICDs:



Gajendran et al, A & A Practice 2021;15:e01465

105

Biotronik Magnet Application: Technical Support Document

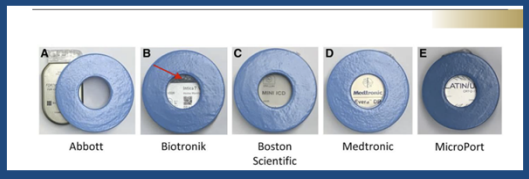
"the opening of the ring rests slightly above the top of the housing"

file:///C:/Users/strec/Downloads/Magnet%20Use%20for%20Temporarily%20Disabling%20Tachycardia%20Detection%20and%20Therapy%20in%20ICD%20Devices%20-%20APS143r1%20(1).pdf

106

1. How should you apply the Magnet?

- Transvenous ICDs:



Gajendran et al, A & A Practice 2021;15:e01465, modified

107

1. How should you apply the Magnet?

- Subcutaneous ICDs:
  - For current S-ICDs (EMBLEM, A209 and A219), center the magnet over the header or the bottom edge of the ICD.

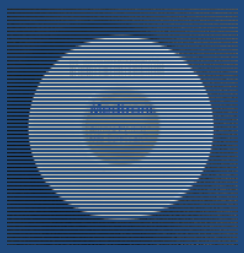
  - For older S-ICDs (SQ-RX S model #1010), center the magnet over the housing

EN_ACL_Magnet Use with BSC CIED_20210421.pdf

110

1. How should you apply the Magnet?

- **Extravascular ICDs**
  - Magnet is applied in same manner as with Medtronic transvenous devices—center over the housing



Medtronic Aurora EV-ICD

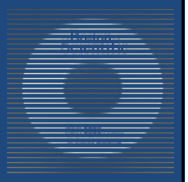
113

Why is there variability in the manufacturers' recommendations for magnet positioning?

114

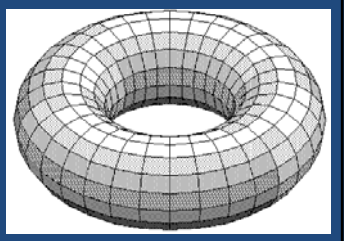
Three Important Magnet Principles

1. Magnets suspend the ATT by activating a Reed Switch/Hall Sensor that is implanted within the housing of the ICD.
2. The position of this activating sensor varies among manufacturers
3. The magnetic field of a ring magnet is maximal on the inner and outer edges; it is minimal in the center.



116

Magnetic Field of Ring Magnet



117

Is Proper Magnet Positioning Important?

CASE REPORT

Appropriate Delivery of Antitachyarrhythmia Therapy Despite Magnet Placement Over Implanted Cardioverter-Defibrillator: A Case Report

Vishal K. Gajendran, MD,* Tahmeed Contractor, MBBS,† Ryan C. Tone, MD,* Carin R. Mascetti, MD,* and Melissa D. McCabe, MD, MSCR*

The fundamental perioperative concern for patients with implantable cardioverter-defibrillators (ICDs) is the potential for electromagnetic interference (EMI) from monopolar electrosurgery. The ICD may interpret electromagnetic signals as a tachyarrhythmia and deliver an inappropriate shock to the patient. Magnet placement is often used to avoid this problem since a magnet will often deactivate an ICD's tachyarrhythmia therapy. We report a case in which magnet placement over an ICD failed to suspend tachyarrhythmia therapy because of imprecise magnet positioning. This case demonstrates the possibility for error when relying on a magnet to suspend tachyarrhythmia therapies. (A&A Practice. 2021;15:e01465.)

A & A Practice 2021;15:e01465

129

Case Report Summary

- Pt with Abbott ICD
- Pt having ileostomy reversal
- Magnet placed centrally over ICD
- VF shortly after induction
- ICD shocked the patient before the anesthesiologist removed magnet

130

Case Report

Magnets and implantable cardioverter defibrillators: What's the problem?

Yilian F Rodriguez-Blanco[1,2,3], Fouad Souki[1,2], Evelyn Tamayo[2], Keith Candiotti[1,2]
[1]Clinical Anaesthesiology, [2]Division of Cardiac Anesthesia, [3]Department of Anaesthesiology, Perioperative Medicine and Pain Management, University of Miami Miller School of Medicine, Miami, Florida

- 66 yo M for oral surgery
- Abbott ICD
- Rep advised placing magnet directly over ICD to disable ATT
- Shortly after monopolar cautery use, a sudden movement noted
- Bipolar cautery used for remainder of procedure
- Post procedure interrogation revealed 1 ATP, 1 shock, and 2 aborted shocks

Annals of Cardiac Anaesthesia 2013 Vol. 16:54-57

137

Quote from Paper

- Regarding the subtle and somewhat vague description of how to place a magnet:

"If such small variations in magnet placement could in fact be responsible for the failure of the ICD inactivation, then magnet placement should not be considered a viable option"

140

Take Home Messages

- Place the magnet according to the manufacturer guidelines, using this limited knowledge of magnet physics and your limited ability to identify the ICD orientation
- Recognize that magnets may fail to suspend the ATT if their magnetic fields are not close enough to the ICD's Reed switch.

142

2. Will the ICD Always Respond to the Magnet?

- Although rarely the case, Bos Sci and Abbott ICDs can be programmed to ignore a magnet

146

Abbott Programmer Reports

Parameters

Patient		Indications for I
Date of Birth	Jul 26, 1937	
EF %	Unknown	

Device	Manufacturer	Model
ICD	St. Jude Medical	Fortify Assura™
A Lead	St. Jude Medical	Tendril® STS 20
V Lead	St. Jude Medical	Durata® 7121Q

Basic Operation	
Mode	DDDR
Magnet Response	Normal
V. Noise Reversion Mode	Pacing Off
Episodal Pacing Mode	DDI
Sensor	On
Threshold (Measured Avg.)	Auto (+0.0) (2.0)
Slope	8
Max Sensor Rate	100 bpm
Reaction Time	Fast
Recovery Time	Medium

Parameters

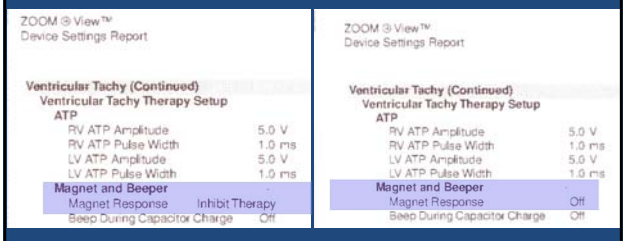
Patient		Indications for I
Date of Birth	Feb 26, 1946	Congestive Heart
EF %	35 %	

Device	Manufacturer	Model
CRT-D	St. Jude Medical	Unify™ 3231-40
A Lead	St. Jude Medical	Tendril® ST Optim
RV Lead	St. Jude Medical	Riata® ST Optim
LV Lead	St. Jude Medical	QuickSite® 1056

Basic Operation	
Mode	DDDR
Ventricular Pacing	Simul.
V. Triggering	Off
Magnet Response	Ignore
V. Noise Reversion Mode	DOO
Episodal Pacing Mode	DDI
Sensor	On
Threshold (Measured Avg.)	Auto (+0.0) (2.0)
Slope	8
Max Sensor Rate	110 bpm

149

Boston Scientific ICD Programmer Reports



ZOOM ⊛ View™
Device Settings Report

Ventricular Tachy (Continued)		
Ventricular Tachy Therapy Setup		
ATP		
RV ATP Amplitude	5.0 V	
RV ATP Pulse Width	1.0 ms	
LV ATP Amplitude	5.0 V	
LV ATP Pulse Width	1.0 ms	
Magnet and Beeper		
Magnet Response	Inhibit Therapy	
Beep During Capacitor Charge	Off	

ICD with typical programming
Magnet will inhibit therapy

ZOOM ⊛ View™
Device Settings Report

Ventricular Tachy (Continued)		
Ventricular Tachy Therapy Setup		
ATP		
RV ATP Amplitude	5.0 V	
RV ATP Pulse Width	1.0 ms	
LV ATP Amplitude	5.0 V	
LV ATP Pulse Width	1.0 ms	
Magnet and Beeper		
Magnet Response	Off	
Beep During Capacitor Charge	Off	

ICD with ATYPICAL programming
Magnet will NOT INHIBIT therapy

151

What if an ICD were programmed to ignore a magnet and the anesthesia team used a magnet to suspend the ATT during surgery?

152

CASE REPORT

Use Caution When Applying Magnets to Pacemakers or Defibrillators for Surgery

Peter M. Schulman, MD* and Marc A. Rozner, PhD, MD†

The application of a magnet to a pacemaker (intended to cause asynchronous pacing) or implanted cardioverter defibrillator (intended to prevent shocks) during surgery without a clear understanding of actual magnet function(s) or precautions can have unexpected, untoward, or harmful consequences. In this report, we present 3 cases in which inadequate assessment of cardiac implanted electronic device (CIED) function, coupled with magnet application, contributed to or resulted in inappropriate antitachycardia pacing or shocks, CIED damage, or patient injury. Although these cases might be rare, they reinforce the need for a timely, detailed preoperative review of CIED function and programming as recommended by the American Society of Anesthesiologists and the Heart Rhythm Society. (Anesth Analg 2013;117:422-7)

- Two Boston Scientific ICDs unknowingly programmed to ignore a magnet:
  - One ICD delivered 20 shocks and 12 ATP rounds and completely depleted the ICD battery

Schulman and Rozner, Anesth Analg 2013;117:422-27

155

Take Home Message

- Bost Sci and Abbott ICDs can be programmed to ignore a magnet
- This is thankfully incredibly rare
- If you want to know for certain, you can confirm the programming with the patient's electrophysiologist or request an interrogation

156

3. What Does the Magnet do to the Anti-Tachy Therapy (ATT)?

- Suspends ATT
- Magnet removal always reactivates ATT
- Only caveat to consider—Biotronik ICDs will automatically re-activate after 8 hours of magnet use.

158

4. What does the Magnet do to the ICD's Pacemaker Component?

- A magnet will not change the pacemaker mode or rate for Medtronic, Abbott, Bost Sci. and Biotronik ICDs
- To modify the ICD's pacemaker mode or rate, must use a programmer.

161

5. What Tone is Emitted from an ICD when a Magnet is Applied?

- Boston Scientific—three possible responses
- Medtronic—three possible responses
- Abbott—two possible responses
- Biotronik—no tone
- MicroPort—no tone

162

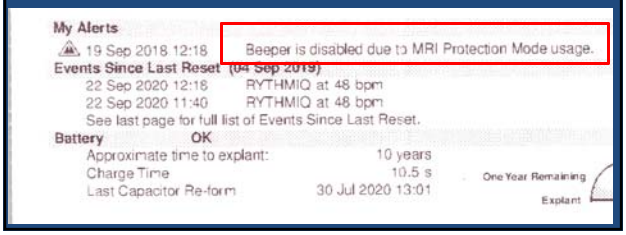
Boston Scientific ICD-Magnet Responses

1. Continual beeping tone
   - Normal response
   - Either every second or R-wave synchronous
   - Lasts as long as magnet is in proper position for transvenous ICDs
   - The S-ICD stops beeping after 60 secs, but ATT is still suspended
2. Monotone
   - ATT was already suspended with a programmer
3. No Tone
   - ICD is programmed to ignore the magnet or
   - The speaker function has been disabled due to MRI exposure (only affects ICDs made prior to Feb 2022)

163

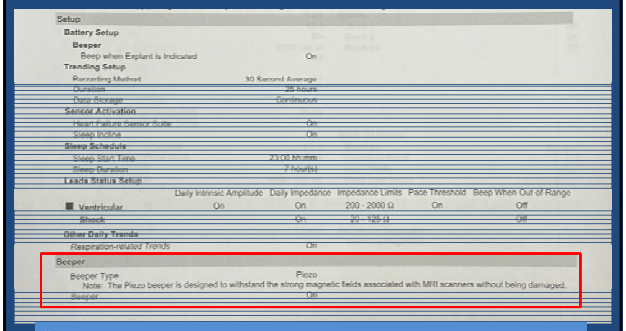
MRIs Disable the Beeping Tone in many Boston Scientific ICDs

- 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



164

Current Boston Scientific ICD Report



"The Piezo beeper is designed to withstand the strong magnetic fields associated with MRI scanners without being damaged."

165

Boston Scientific ICD Continual Beeping Tone

The S-ICD emits the same tone, but only for 60 seconds

166

Medtronic ICD-Magnet Responses

1. Monotone for 10 sec
   - Indicates normal device function
2. On-Off tone for 10 sec
   - Clinician alert/device issue
3. High-Low tone for 10 sec
   - Clinician alert/device issue

168

Normal Medtronic ICD 10-second Monotone

170

Medtronic ICD with High-Low Alert

171

Abbott/St Jude ICD-Magnet Responses

1. Two Tones:
   -The Gallant and Entrant models:
   - 4-sec monotone upon magnet application
   - 6-sec higher-pitched monotone upon magnet removal

2. No Tone:
   -All other Abbott ICDs

173

Abbott Gallant/Entrant ICD Tone

174

Editorial Comment

In my opinion, the lack of a continuous indication of suspension of tachyarrhythmia therapy from an ICD is a design flaw and represents another argument for reprogramming an ICD instead of applying a magnet.

G. Alec Rooke A & A Practice Sept 2020

175

6. Do Magnets reliably inhibit the ICD?

Answer: Not Always

This is particularly true in patients in the lateral or prone position, pts with obesity, and pts with the surgical site near the ICD

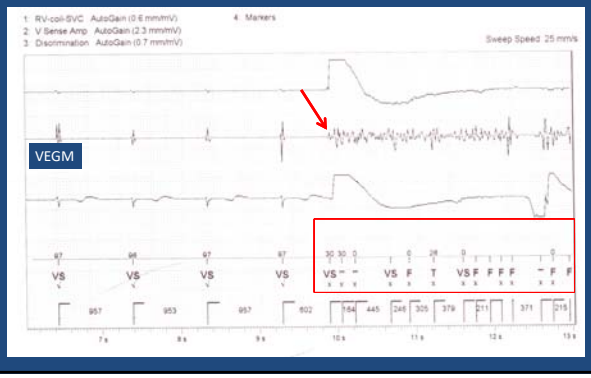
232

Lateral Position for Thoracic Surgery

- Pt with transvenous ICD
- Having VATS procedure
- Anesthesiologist secured a magnet on the ICD

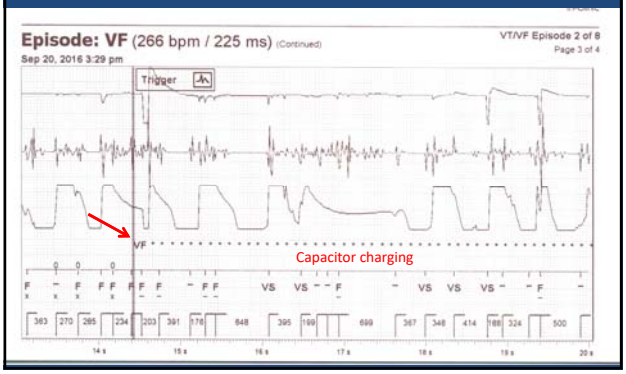
233

Cautery Detected as VF



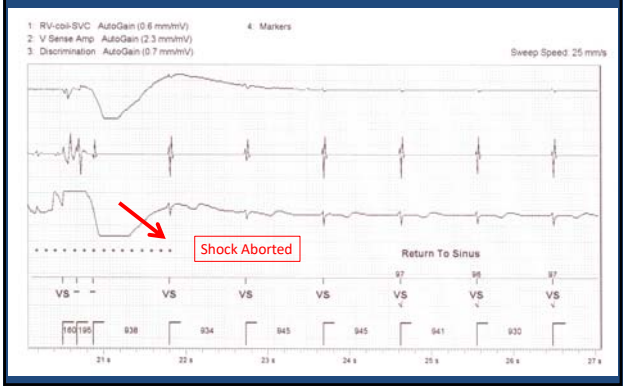
234

VF declared—charging starts



235

Charging ends…ICD attempts to confirm VF, but cautery stopped and VS intervals return..no shock



236

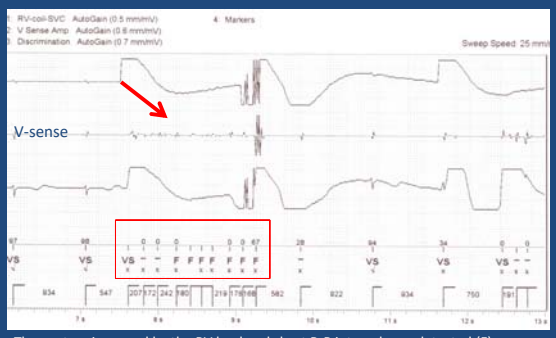
Is the Aborted Shock Benign?

- The ICD charging diminishes battery life even when the charge is not delivered.
- A full charge may consume as much as 30-46 days of the ICD's battery life

Manufacturer reports; Tang et al, JCTVA June 2025

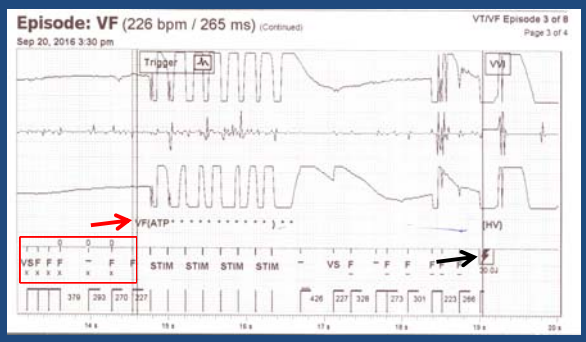
237

30 secs later Cautery detected again



The cautery is sensed by the RV lead and short R-R intervals are detected (F)
…when cautery is off, SR is detected (VS).

238



At the red arrow, the ICD detects VF after sensing 12 short R-R intervals classified as "F". The charging ensues as ATP is delivered. Charging is very short because the ICD had charged the capacitor at 3:29, but aborted. The ICD confirmed that VF was continuing and shocked with 30 J at the black arrow

239

Why is this so Bad?

- Unnecessary shocks can initiate VF
- Shocks are bad for the heart
- An awake patient would be “shocked”
- Shocks can also move the patient dangerously if the patient is not fully relaxed:
  - Delicate surgery
  - Head in pins

240

Magnet use may fail with Patients in Prone Position

- Pt with Abbott ICD
  - Magnet response enabled
- Pt’s head in pins
- Magnet placed on ICD and secured with Tegaderm
- Patient fully relaxed with NMBs

241

Post-Op Interrogation Revealed:

Therapy Summary	VT	VF
ATP Delivered		11
Shocks Delivered		19
Max Energy Shocks		4
	VT Zone is Monitor Only	
Last HV Lead Impedance	57 Ω	
Total Aborted Shocks	29	

Results of ATP Delivery	VT	VF
Episodes Terminated	0	5
Episodes Not Terminated	0	6
Accelerations	0	

- 11 rounds of ATP
- 19 shocks delivered
- 29 aborted shocks
- Battery Life reduced from 5.4 years to 3.8 years

243

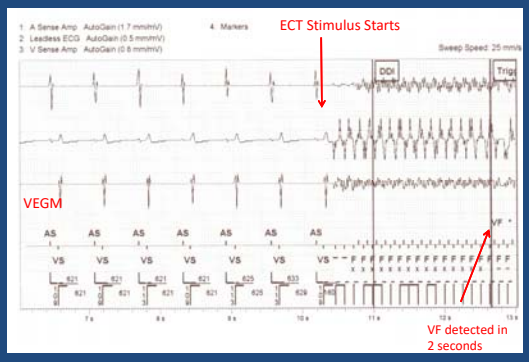
Magnet use may fail in Obese Patients: ECT and ICD Shock

- 49 yo obese pt with Depression
- Abbott ICD
- Anesthesia team used magnet to suspend ATT
- 8-sec ECT stimulus delivered

Streckenbach et al, A & A Practice 2020

245

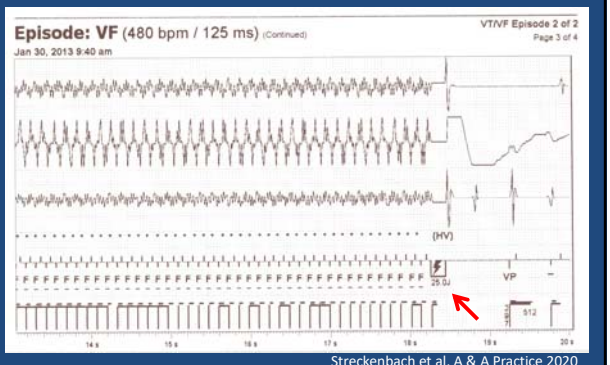
ECT ICD Shock



Streckenbach et al, A & A Practice 2020

246

ECT ICD Shock



Streckenbach et al, A & A Practice 2020

247

Magnets may fail when Surgery near ICD:
Thyroid Surgery and ICD Shocks

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

Recordings - Episodes

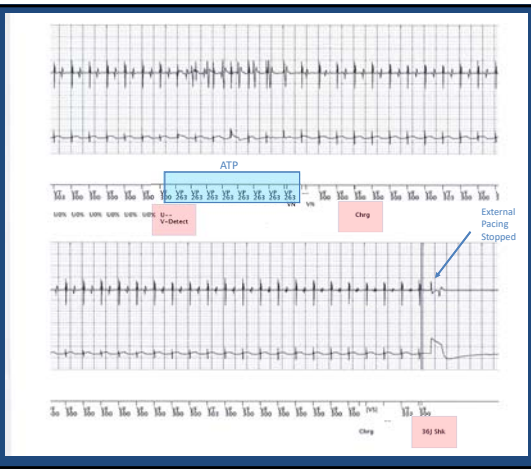
No.	Time	Zone	PP [ms]	RR [ms]	Description	PP [ms]	RR [ms]
90		VF	589	164	1 Shock	***	***
89		VF	219	147		965	973
88		VF	690	171	1 Shock	***	***
87		---	604	604	Periodic IEGM	***	***
86		ATR	180	779		690	696

249

Magnets may fail when Surgery near ICD:
Magnet use During a TAVR

- Magnet placed on Boston Scientific ICD, but unknowingly displaced

251



252

Magnet Failure in Supine Patient with an S-ICD

Case Reports > A A Pract. 2020 Apr;14(6):e01178. doi: 10.1213/XAA.0000000000001178.

Unexpected Shocks From a Subcutaneous Implantable Cardioverter-Defibrillator Despite Attempted Reprogramming and Magnet Use: A Case Report

Colleen M McFaul [1], Stefan Lombaard [2], Vivek Arora [2], William C Van Cleve [2], G Alec Rooke [2], Jordan M Prutkin [3]

Affiliations + expand

PMID: 32224692 DOI: 10.1213/XAA.0000000000001178

Abstract

We present the case of a patient with a subcutaneous implantable cardioverter-defibrillator (S-ICD) in situ. Device interrogation and reprogramming were unsuccessful due to a software mismatch between the device and programmer. The device manufacturer recommended magnet application to suspend antitachycardia therapy. Despite using this strategy, the S-ICD discharged multiple times. The S-ICD has unique perioperative considerations for the anesthesiologist. This case provides an example of the complexity of electrophysiologic devices in current use and the necessity of the anesthesia provider to stay up to date with evolving device management strategies.

254

Case Summary

- Patient having heart-kidney Tx
- Has Emblem MRI Bost Sci S-ICD
- No HO of MRI exposure
- Team tried to reprogram but programmer not communicating with the S-ICD
- Placed a magnet but did not appreciate any beeping tone (noisy OR and did not use stethoscope)
- Patient supine
- After XC removal pt had VF—three external shocks given, but also three unexpected chest wall movements
- Post interrogation demonstrated 3 ICD shocks delivered
- Not sure if magnet was initially positioned appropriately or not vs moving off the intended position due to gravity during procedure

McFaul CM et al. A&A Practice. 202;14:e01178

255

Take Home Message from this Paper

"Magnet deactivation of S-ICD is less reliable than TV-ICDs and should only be used in emergencies with careful consideration of intricacies of magnet use."

McFaul CM et al. A&A Practice. 2020;14:e01178

256

Magnets are not so Reliable!

- In most of these cases the anesthetists did not know the shocks had occurred.
- I suspect this happens more often than we would like to think

257

Benefits vs Risks of Magnets

- Benefits
  - Easy to use
  - If pt. develops dysrhythmia, can remove magnet
  - No risk of sending patient home with ICD off
- Risks:
  - Skin necrosis from prolonged pressure
  - **The magnet will fail to suspend the ATT**

258

The most reliable way to avoid the risk associated with using a magnet is to use a programmer to suspend the ICD's anti-tachy therapy

260

Using a Programmer to Suspend ICD Therapy

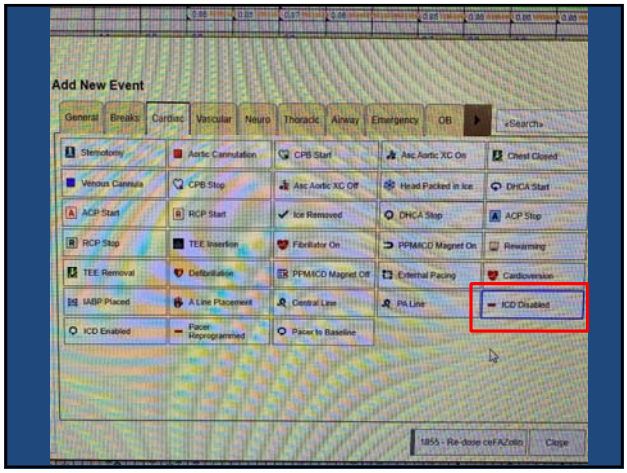
- Essentially 100% reliable
- Requires someone with programmer training
- Relatively easy to learn how to suspend ATT

261

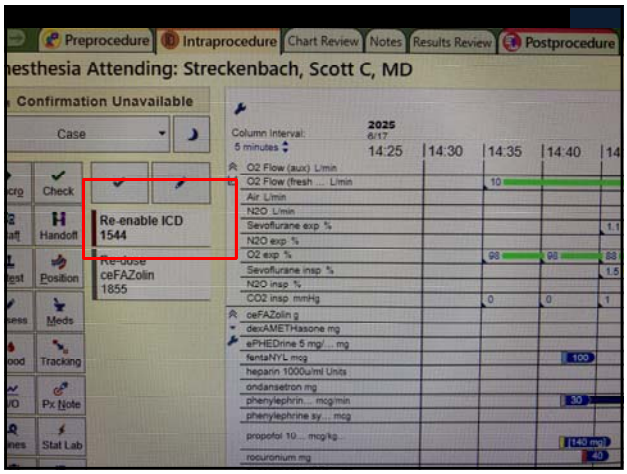
Risks Associated with Using a Programmer to Suspend ATT

- Inadequate response by anesthesia team if pt develops VF
- Sending patient home with ATT still suspended

262



264

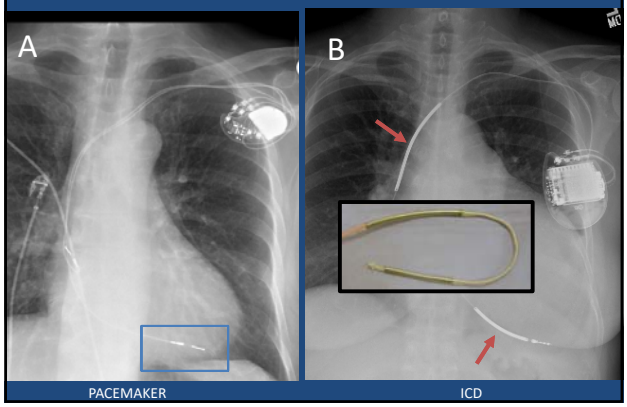


265

How to Use the CXR

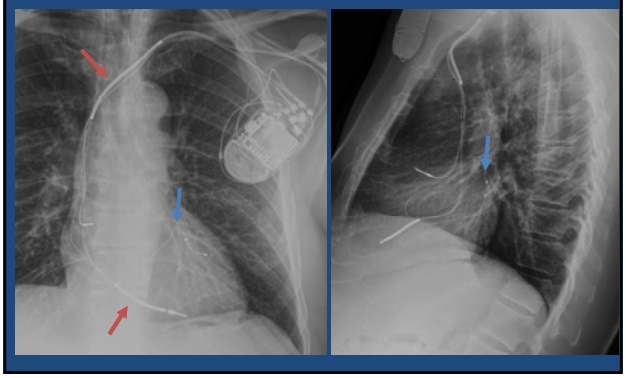
287

Pacemaker vs Standard ICD



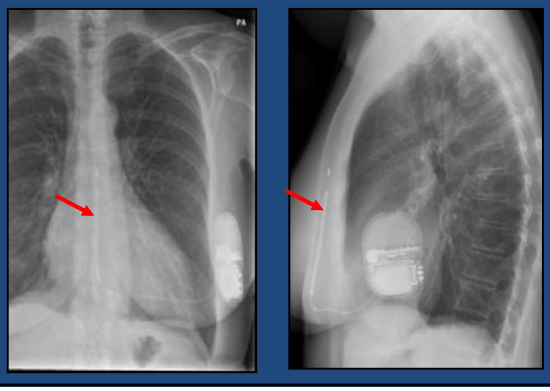
291

Standard ICD vs CRT-D?



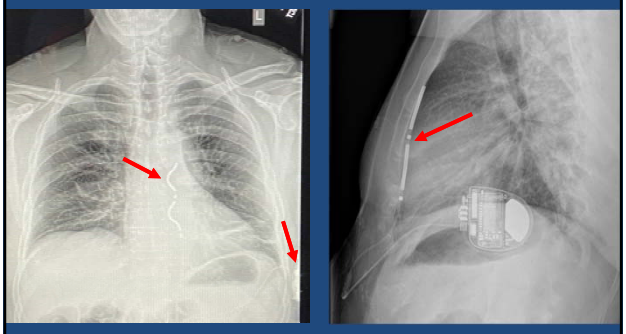
294

Boston Scientific S-ICD



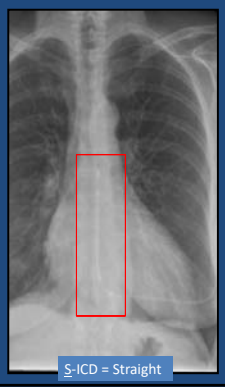
298

Medtronic Aurora EV-ICD

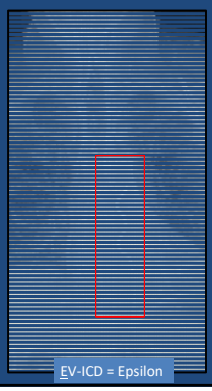


300

Bost Sci S-ICD vs Med Aurora EV-ICD



S-ICD = Straight



EV-ICD = Epsilon

302

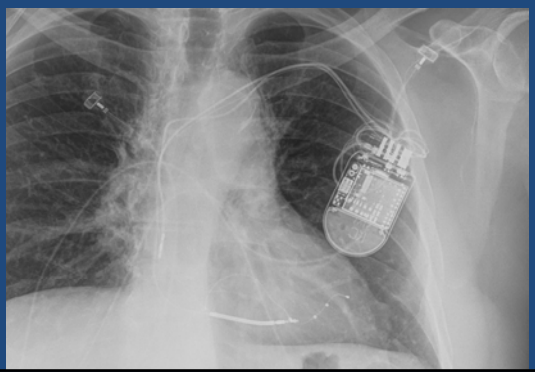
Determination of the ICD's Manufacturer

- Each Manufacturer has a characteristic alphanumeric or symbolic CXR identifier

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

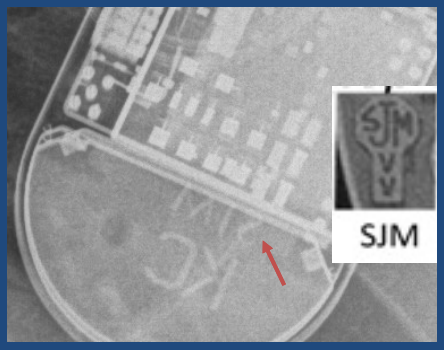
307

Abbott/St. Jude



308

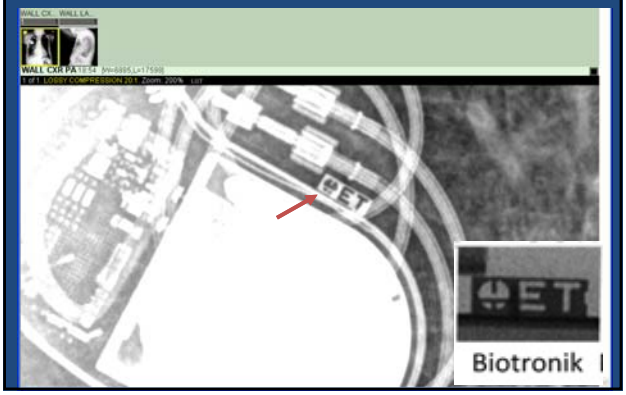
Abbott/St. Jude



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

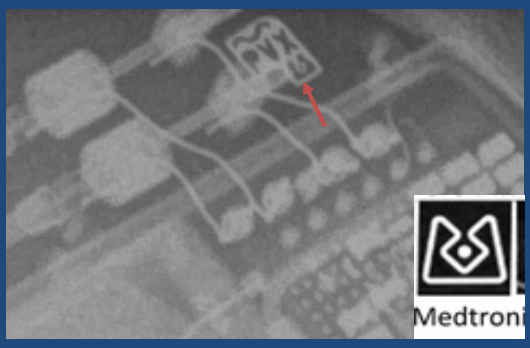
309

Biotronik



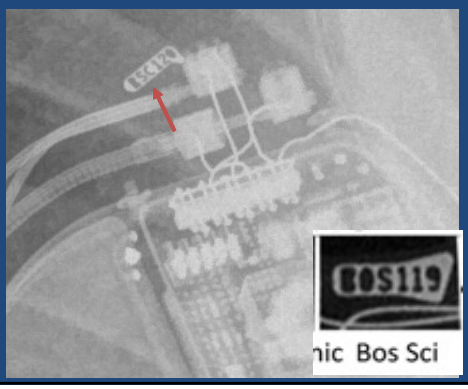
310

Medtronic



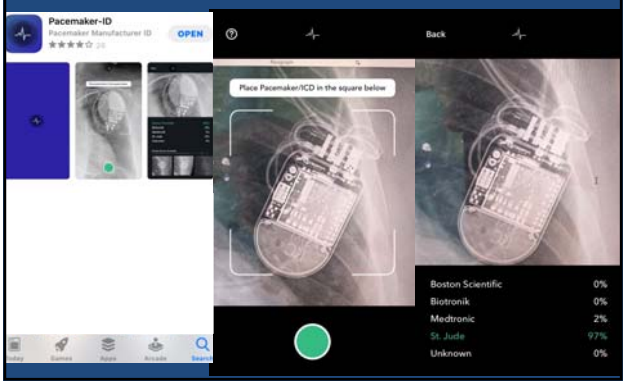
311

Boston Scientific



313

Pacemaker-ID App



315

Four Society Publications That Can Guide Your Management

1. HRS/ASA Expert Consensus Statement 2011
2. ASA Practice Advisory Update 2020
3. British Heart Rhythm Society Guidelines 2022
4. AHA Scientific Statement on Care for Patients with CIEDs 2024

323

Important Publications to Guide Periop Management

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§] Samuel J. Asirvatham, MD, FHRS,[4] Alan Cheng, MD, FHRS,[5¶] Mina K. Chung, MD, FHRS,[6] T. Bruce Ferguson, Jr., MD,[7##] John D. Gallagher, MD,[8§] Michael R. Gold, MD, PhD, FHRS,[9#] Robert H. Hoyt, MD,[10] Samuel Irefin, MD,[11§] Fred M. Kusumoto, MD, FHRS,[12] Liza Prudente Moorman, MSN, ACNP, FHRS,[13] Annemarie Thompson, MD[14§]

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

Heart Rhythm July 2011; 1114-1154

324

Important Publications to Guide Periop Management

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**

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

Anesthesiology 2020;132:225-52

325

Important Publications to Guide Periop Management

British Heart Rhythm Society Guidelines 2022

Anaesthesia 2022, 77, 808-817 doi:10.1111/anae.15728

Guidelines

Guidelines for the peri-operative management of people with cardiac implantable electronic devices

Guidelines from the British Heart Rhythm Society

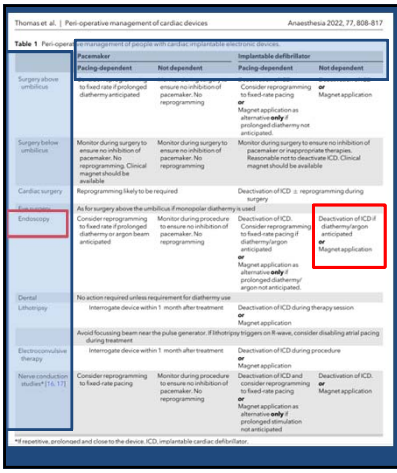
H. Thomas,[1] C. Plummer,[2] I. J. Wright,[3] P. Foley[4] and A. J. Turley[5]

1 Consultant, Department of Cardiology, Northumbria Healthcare NHS Foundation Trust, Northumberland, UK
2 Consultant, Department of Cardiology, Newcastle upon Tyne NHS Foundation Trust, Newcastle upon Tyne, UK
3 Physiologist, Department of Cardiology, Imperial College Healthcare NHS Foundation Trust, London, UK
4 Consultant, Department of Cardiology, Great Western Hospitals NHS Foundation Trust, Swindon, UK
5 Consultant, Department of Cardiology, South Tees NHS Foundation Trust, Middlesbrough, UK

- Written by 5 cardiologists
- Provides a clinically useful definition of pacer dependency
- Covers loop recorders, insertable cardiac monitors, remote monitoring
- Helpful chart on how to manage ICDs and pacemakers in the OR

Anaesthesia 2022, 77, 808-17

327



Thomas et al. | Peri-operative management of cardiac devices Anaesthesia 2022, 77, 808-817

Table 1 Peri-operative management of people with cardiac implantable electronic devices.

	Pacemaker		Implantable defibrillator	
	Pacing-dependent	Not dependent	Pacing-dependent	Not dependent
Surgery above umbilicus	to fixed rate if prolonged diathermy anticipated	ensure no inhibition of pacemaker. No reprogramming	Consider reprogramming to fixed-rate pacing **or** Magnet application as alternative **only** if prolonged diathermy not anticipated.	**or** Magnet application
Surgery below umbilicus	Monitor during surgery to ensure no inhibition of pacemaker. No reprogramming. Clinical magnet should be available	Monitor during surgery to ensure no inhibition of pacemaker. No reprogramming	Monitor during surgery to ensure no inhibition of pacemaker or inappropriate therapies. Reasonable not to deactivate ICD. Clinical magnet should be available	
Cardiac surgery	Reprogramming likely to be required		Deactivation of ICD ± reprogramming during surgery	
Endoscopy	As for surgery above the umbilicus if monopolar diathermy is used			
	Consider reprogramming to fixed rate if prolonged diathermy or argon beam anticipated	Monitor during procedure to ensure no inhibition of pacemaker. No reprogramming	Deactivation of ICD. Consider reprogramming to fixed-rate pacing if diathermy/argon anticipated **or** Magnet application as alternative **only** if prolonged diathermy/ argon not anticipated.	Deactivation of ICD if diathermy/argon anticipated **or** Magnet application
Dental	No action required unless requirement for diathermy use			
Lithotripsy	Interrogate device within 1 month after treatment		Deactivation of ICD during therapy session **or** Magnet application	
	Avoid focussing beam near the pulse generator. If lithotripsy triggers on R-wave, consider disabling atrial pacing during treatment			
Electroconvulsive therapy	Interrogate device within 1 month after treatment		Deactivation of ICD during procedure **or** Magnet application	
Nerve conduction studies*[16,17]	Consider reprogramming to fixed-rate pacing	Monitor during procedure to ensure no inhibition of pacemaker. No reprogramming	Deactivation of ICD and consider reprogramming to fixed-rate pacing **or** Magnet application as alternative **only** if prolonged stimulation not anticipated	Deactivation of ICD. **or** Magnet application

*If repetitive, prolonged and close to the device. ICD, implantable cardiac defibrillator.

Describes how to manage patients with pacemakers or ICDs who are and who are not pacemaker dependent when they are undergoing different procedures

Anaesthesia 2022, 77, 808-17

328

Important Publications to Guide Periop Management

2024 AHA Scientific Statement on Management of Patients with CIEDs

AHA SCIENTIFIC STATEMENT

Periprocedural Management and Multidisciplinary Care Pathways for Patients With Cardiac Implantable Electronic Devices: A Scientific Statement From the American Heart Association

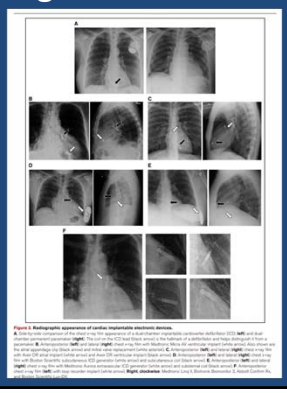
Elaine Y. Wan, MD, FAHA, Vice Chair*; Albert J. Rogers, MD, MBA, Chair*; Michael Lavelle, MD; Mason Marcus, MD; Sarah A. Stone, MD, MS; Linda Ottoboni, PhD, CNS; Uma Srivatsa, MBBS, MAS; Miguel A. Leal, MD; Andrea M. Russo, MD, FAHA; Larry R. Jackson II, MD, MHSc; George H. Crossley, MD, FAHA; on behalf of the American Heart Association Electrocardiography and Arrhythmias Committee of the Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Cardiovascular Surgery and Anesthesia; and Council on Peripheral Vascular Disease

- Best coverage of Leadless Pacemakers and new ICDs
- Excellent section on EMI-CIED interactions in various OR environments
- Excellent CXR section

Circulation 2024;150: e183-196

329

CXR Images of Various CIEDs



331

Perioperative ICD Management

- Preoperative management
- Intraoperative management
- Postoperative management

336

Preoperative Management

1. Assess patient's device:
   a. Determine last ICD interrogation
      - 2011 HRS/ASA Consensus Statement: Within 6 months
      - 2024 AHA Scientific Statement: Within 3 months
      - Should be immediately preop if any signs or symptoms that could indicate ICD dysfunction*

   b. Obtain the pertinent device information

339

"The best prescription for perioperative management is for the EP team to communicate pertinent device information to the OR team"

2011 HRS/ASA Consensus Statement

340

Pertinent Information EP Team should provide

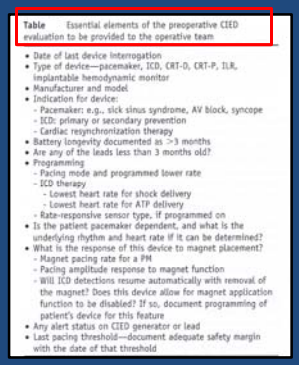


Table Essential elements of the preoperative CIED evaluation to be provided to the operative team

- Date of last device interrogation
- Type of device—pacemaker, ICD, CRT-D, CRT-P, ILR, 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 detections 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

*2011 HRS/ASA Consensus Statement Heart Rhythm July 2011; p 1126

342

Essential Information EP should provide

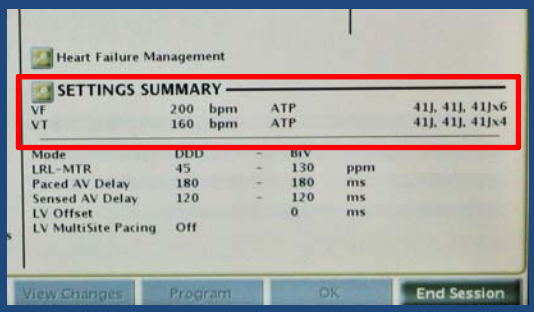
- Type of device
- Manufacturer
- Location of device
- Last interrogation
- Pacing dependence
- Battery and lead status
- Current settings
  - Pacemaker
  - ICD treatment zones

MASSACHUSETTS GENERAL HOSPITAL

MGH PACEMAKER/ICD PREOP EVALUATION FORM

345

Boston Scientific ICD Treatment Zones

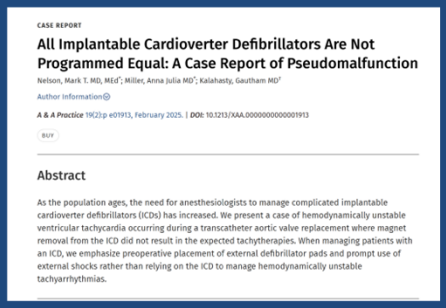


346

Do I need to know what the specific Anti-Tachy Treatment Parameters are?

347

Knowing the Treatment Parameters Can Help



CASE REPORT

All Implantable Cardioverter Defibrillators Are Not Programmed Equal: A Case Report of Pseudomalfunction

Nelson, Mark T. MD, MEd*; Miller, Anna Julia MD*; Kalahasty, Gautham MD†

Author Information

A & A Practice 19(2):p e01913, February 2025. | DOI: 10.1213/XAA.0000000000001913

BUY

Abstract

As the population ages, the need for anesthesiologists to manage complicated implantable cardioverter defibrillators (ICDs) has increased. We present a case of hemodynamically unstable ventricular tachycardia occurring during a transcatheter aortic valve replacement where magnet removal from the ICD did not result in the expected tachytherapies. When managing patients with an ICD, we emphasize preoperative placement of external defibrillator pads and prompt use of external shocks rather than relying on the ICD to manage hemodynamically unstable tachyarrhythmias.

Anesthesia & Analgesia Practice Feb 2025

348

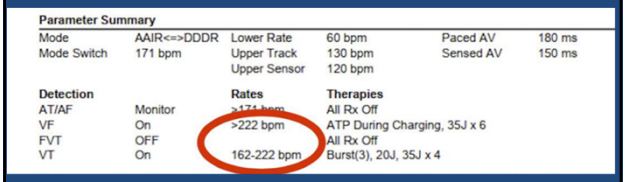
What Happened?

- Pt with Medtronic ICD having TAVR
- Magnet used to suspend ATT
- Paced 180 for deployment
- After deployment → unstable VT at 159
- Magnet removed but "no shock for 15-30 s"
- External asynchronous shock 360J→ VF
- ICD then delivered shock → SR

Nelson, et al. Anesthesia & Analgesia Practice Feb 2025

349

Programmer Report



Parameter Summary					
Mode	AAIR<=>DDDR	Lower Rate	60 bpm	Paced AV	180 ms
Mode Switch	171 bpm	Upper Track	130 bpm	Sensed AV	150 ms
		Upper Sensor	120 bpm		
Detection		**Rates**	**Therapies**		
AT/AF	Monitor	>171 bpm	All Rx Off		
VF	On	>222 bpm	ATP During Charging, 35J x 6		
FVT	OFF		All Rx Off		
VT	On	162-222 bpm	Burst(3), 20J, 35J x 4		

The patient's VT rate (159) was below the VT treatment zone (162-222)

Nelson, et al. Anesthesia & Analgesia Practice Feb 2025

351

Take Home Message

It is useful to know the ICD's treatment parameters when you will use a magnet to suspend the ATT, particularly if the patient has a history of VT.

352

Preoperative Management

2. Assess Surgical Situation:
   a. Is cautery required?
   b. What is the patient position?
   c. Where is the surgical site?
   d. Will you have access to the device?
   e. How long is the surgery?

Need to assess EMI risk / applicability of magnet use

360

Preoperative Management

3. Define a Plan:
   a. Make no device change
   b. Suspend anti-tachy therapy (ATT)
      a. Use Magnet
      b. Re-program the ICD
   c. Suspend ATT and re-program pacemaker
      a. Re-program the ICD

363

Key Question #1: When should you suspend the ATT?

ATT=Anti-tachy detection and therapy

366

When Does the ICD ATT Need to be Turned Off?

- Key Statements from the 2011 HRS/ASA Cons Statement:
  - 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 Consensus Statement

368

When Does the ICD ATT Need to be Turned Off?

- Key Statement from 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

370

The 2022 ASA Practice Advisory makes no recommendation about ICD management in patients having surgery below the umbilicus.

371

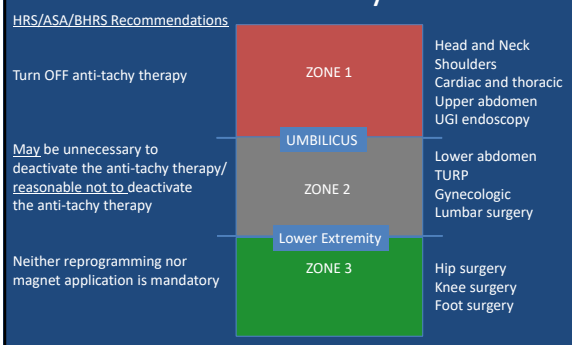
British Heart Rhythm Society Guidelines 2022

- Regarding surgery below the umbilicus:

Monitor during surgery to ensure no inhibition of pacemaker or inappropriate therapies. Reasonable not to deactivate ICD. Clinical magnet should be available

372

Summary



373

What Evidence Supports these Recommendations?

378

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

379

Brief Study Results Summary

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

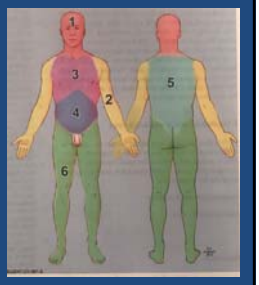
380

Results

Table 4 Surgery location and EMI detection

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	5	0 (0)
Hip, lower extremity	24	0 (0)
Total	103	11 (11)

Dispersive grounding pad applied to lower extremities in all cases

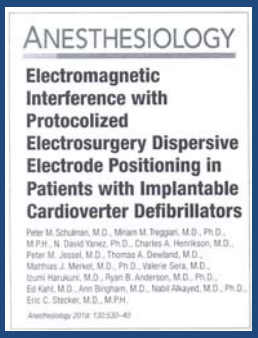


This study supports not suspending the ATT for lower extremity surgery

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

381

ICD-Cautery Study 2019


ANESTHESIOLOGY

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

- Analyzed 144 patients with ICDs who were having surgeries in various parts of the body
- Determined what the ICDs (Bos Sci and Medtronic) were "seeing" during the surgery

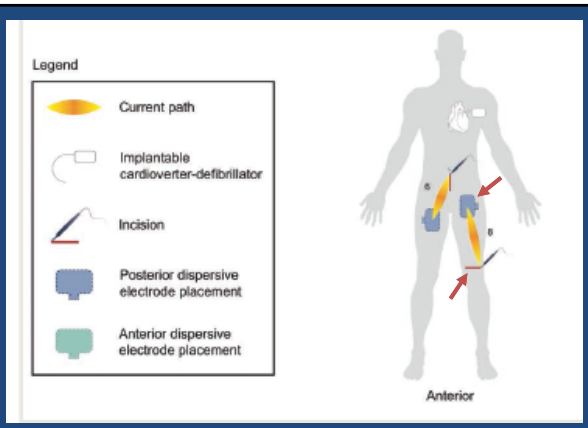
Schulman et al, Anesthesiology April 2019

382

Study Protocol

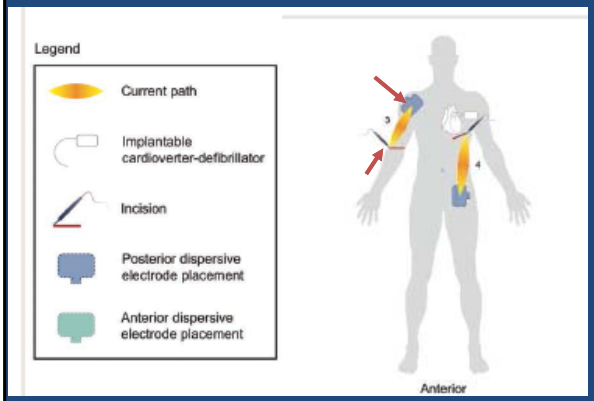
Schulman et al, Anesthesiology April 2019: Infographic: J Wanderer

383



Schulman et al, Anesthesiology April 2019

385



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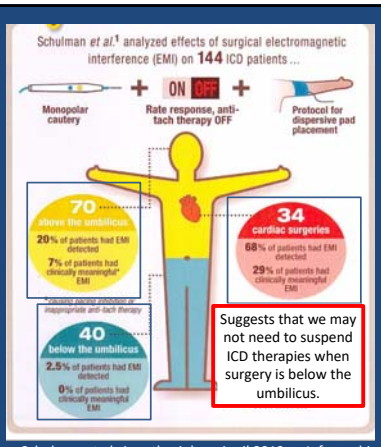


Schulman et al, Anesthesiology April 2019: Infographic: J Wanderer

390

Key Concept

Pay attention to bovie return pad placement

OR nurses may need guidance

402

- 71 yo for Left Hip arthroplasty
- "Patient return electrode placed on pt's back at the level of umbilicus"
- "No magnet used—followed ASA Practice Advisory"
- Pt had 9 shocks and 4 rounds of ATP
- Battery life decreased from 5.6 years to 4.1 years

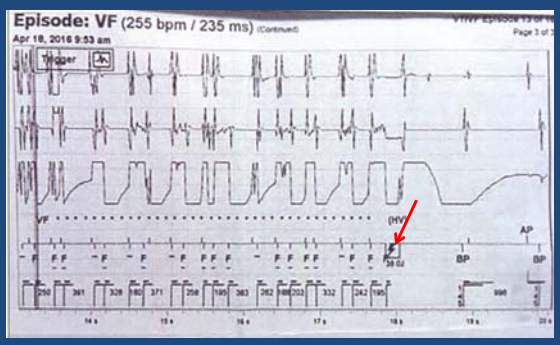
403

- 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/ASA Consensus paper" and did not inhibit ICD

Kleinman B, et al APSF Newsletter June 2017

407

Intraop Shock



The ICD also delivered 1 round of ATP and had 7 aborted shocks

408

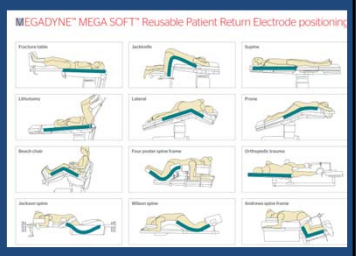
Be Aware of the Underbody Dispersive Electrode Pad System: Megadyne

417

Megadyne Under Body Dispersive Pad

- WARNING—Avoid this if your patient has an ICD

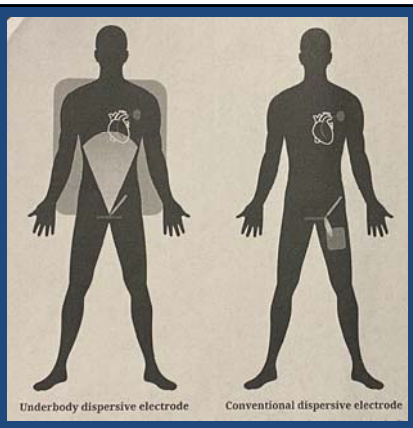

Electromagnetic Interference With an Underbody Dispersive Electrode in a Patient With an Implantable Cardioverter-Defibrillator Undergoing Noncardiac Surgery: A Case Report



Ethicon Website; Megadyne system

Tully et al A&A Practice Sept 24, 2020

418



Tully et al A&A Practice Sept 24, 2020

421

Inappropriate Shocks and the Megadyne Underbody Dispersive Electrode

- Two patients having lower extremity surgery with the Megadyne UDE
  - Bilateral lower extremities for burn debridement
    - 7 shocks and 2 ATP
  - Subtrochanteric revision
    - 3 shocks and 3 ATP

Singleton MJ et al, JCTVA Jan 2022: 236-41

423

Should you Suspend ATT? Final Verdict

1. Surgery above umbilicus—suspend ATT
2. If Megadyne system used—suspend ATT
3. Surgery below umbilicus—modest support for NOT suspending ATT
4. Surgery on lower extremities—stronger support for NOT suspending ATT

- However, to guarantee the patient is not shocked, or if you just want to be ultraconservative, suspend the ATT, even for surgeries on the lower extremities

427

My Approach

*Given that I have my own programmers, **I** suspend almost every ICD as I do not want to take any chance of unintended shocks or unrecognized battery depletion*

431

Key Question #2

- How should you suspend the ICD's ATT—Programmer or Magnet?

433

Suspend Anti-Tachy Therapy with a Programmer if:

1. You need to modify the patient's pacemaker settings
2. Not sure how the ICD will respond to a magnet
3. Gravity may displace the magnet
4. Surgery will preclude easy access to the ICD
5. The ICD is difficult to palpate—obesity or recent implant
6. There is concern for magnet-related tissue necrosis
7. You cannot take chance that patient will get shocked

440

Suspend Anti-Tachy Therapy with a Magnet if:

1. No access to a programmer
2. Want to minimize interventions
3. Worried about external-defibrillating capability
4. Do not want to take any chance of the patient being discharged with the ATT off

445

Intraop Management

- Continuous cardiac monitoring
- Backup defibrillation/pacing capability
- Strategic electrocautery return pad placement
- Deploy lowest effective cautery output
- Watch for inappropriate shocks, ATP, or pacemaker dysfunction related to EMI

449

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

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

453

Intraop Situation #1

- If you used a magnet to inhibit the ICD, 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

457

Intraop Situation #2

- If you used a magnet to inhibit the ICD what, will you do if the patient develops VT?
  - Remove magnet and let ICD manage?
  - Shock the patient with Ext. Defib Pads?

My answer: If HD's allow and VT rate exceeds ICD's "cutoff" rate, remove the magnet and let the ICD deliver ATP

459

Postoperative Management

- Three possible situations:
  1. High-risk procedure or situation: Interrogate ICD Prior to D/C from a monitored setting (PACU, ICU)

*2011 HRS/ASA Consensus Statement

461

Which Pts Need Interrogation Prior to Discharge from a 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, or temp pacing
4. Pt had emergency surgery above umbilicus
5. Pt had RFA or Therapeutic Radiation
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 Heart Rhythm July 2011; 1131

462

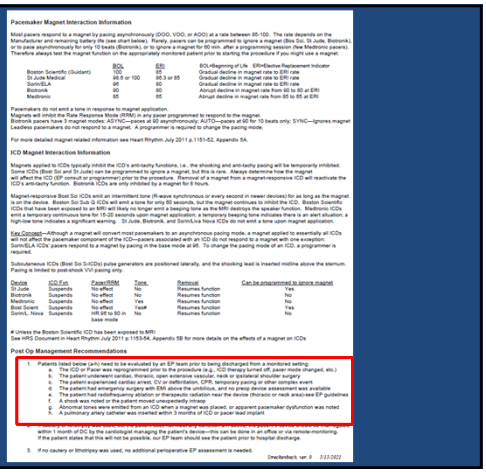
Which Pts Need Interrogation Prior to Discharge from a Monitored Setting?

Table 9 Indications for the interrogation of CIEDs prior to patient discharge or transfer from a cardiac telemetry environment

- 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 aneurysmal 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.*

*2011 HRS/ASA Consensus Statement Heart Rhythm July 2011; p 1126

463



Pacemaker Magnet Interaction Information

Most pacers respond to a magnet by pacing asynchronously (DOO, VOO, or AOO) at a rate between 85-100. The rate depends on the Manufacturer and remaining battery life (see chart below). Rarely, pacers can be programmed to ignore a magnet (Boss Sci, St Jude, Biotronik), or to pace asynchronously for only 10 beats (Biotronik), or to ignore a magnet for 60 min. after a programming session (few Medtronic pacers). Therefore always test the magnet function on the appropriately monitored patient prior to starting the procedure if you might use a magnet.

	BOL	ERI	
Boston Scientific (Guidant)	100	85	BOL=Beginning of Life ERI=Elective Replacement Indicator
St Jude Medical	90 ß or 100	85 ß or 85	Gradual decline in magnet rate to ERI rate
Sorin/LivaNova	90	80	Gradual decline in magnet rate to ERI rate
Biotronik	90	80	Abrupt decline in magnet rate from 90 to 80 at ERI
Medtronic	85	65	Abrupt decline in magnet rate from 85 to 65 at ERI

Pacemakers do not emit a tone in response to magnet application.
Magnets will inhibit the Rate Response Mode (RRM) in any paser programmed to respond to the magnet.
Biotronik pacers have 3 magnet modes: AOYNC—paces at 90 asynchronously; AUTO—paces at 90 for 10 beats only; SYNC—ignores magnet
Leadless pacemakers do not respond to a magnet. A programmer is required to change the pacing mode.

For more detailed magnet related information see Heart Rhythm July 2011 p.1151-62, Appendix 5A.

ICD Magnet Interaction Information

Magnets applied to ICDs typically inhibit the ICD's anti-tachy functions, i.e., the shocking and anti-tachy pacing will be temporarily inhibited. Some ICDs (Bost Sci and St Jude) can be programmed to ignore a magnet, but this is rare. Always determine how the magnet will affect the ICD (EP consult or programmer) prior to the procedure. Removal of a magnet from a magnet-responsive ICD will reactivate the ICD's anti-tachy function. Biotronik ICDs are only inhibited by a magnet for 8 hours.

Magnet-responsive Bost Sci ICDs emit an intermittent tone (R-wave synchronous or every second in newer devices) for as long as the magnet is on the device. Boston Sci Sub-Q ICDs will emit a tone for only 60 seconds, but the magnet continues to inhibit the ICD. Boston Scientific ICDs that have been exposed to an MRI will likely no longer emit a beeping tone as the MRI destroys the speaker function. Medtronic ICDs emit a temporary continuous tone for 15-20 seconds upon magnet application; a temporary beeping tone indicates there is an alert situation; a high-tone tone indicates a significant warning. St Jude, Biotronik, and SorinLiva Nova ICDs do not emit a tone upon magnet application.

Key Concept—Although a magnet will convert most pacemakers to an asynchronous pacing mode, a magnet applied to essentially all ICDs will not affect the pacemaker component of the ICD—pacers associated with an ICD do not respond to a magnet with one exception: Sorin/ELA ICDs' pacers respond to a magnet by pacing in the base mode at 90. To change the pacing mode of an ICD, a programmer is required.

Subcutaneous ICDs (Bost Sci S-ICDs) pulse generators are positioned laterally, and the shocking lead is inserted midline above the sternum. Pacing is limited to post-shock VVI pacing only.

Device	ICD Fxn	Pacer/RRM	Tone	Removal	Can be programmed to ignore magnet
St Jude	Suspends	No effect	No	Resumes function	Yes
Biotronik	Suspends	No effect	No	Resumes function	No
Medtronic	Suspends	No effect	Yes	Resumes function	No
Bost Scientific	Suspends	No effect	Beep	Resumes function	Yes
Sorin/L. Nova	Suspends	MR 85 to 90 in base mode	No	Resumes function	No

Unless the Boston Scientific ICD has been exposed to MRI
See HRS Document in Heart Rhythm July 2011 p.1153-54, Appendix 5B for more details on the effects of a magnet on ICDs

Post Op Management Recommendations

1. Patients listed below (a-h) need to be evaluated by an EP team prior to being discharged from a monitored setting:
   a. The ICD or Pacer was reprogrammed prior to the procedure (e.g., ICD therapy turned off, pacer mode changed, etc.)
   b. The patient underwent cardiac, thoracic, open extensive vascular, neck or ipsilateral shoulder surgery
   c. The patient experienced cardiac arrest, CV or defibrillation, CPR, temporary pacing or other complex event
   d. The patient had emergency surgery with EMI above the umbilicus, and no preop device assessment was available
   e. The patient had radiofrequency ablation or therapeutic radiation near the device (thoracic or neck area)-see EP guidelines
   f. A shock was noted or the patient moved unexpectedly intraop
   g. Abnormal tones were emitted from an ICD when a magnet was placed, or apparent pacemaker dysfunction was noted
   h. A pulmonary artery catheter was inserted within 3 months of ICD or pacer lead implant

within 1 month of DC by the cardiologist managing the patient's device—this can be done in an office or via remote-monitoring. If the patient states that this will not be possible, our EP team should see the patient prior to hospital discharge.

3. If no cautery or lithotripsy was used, no additional perioperative EP assessment is needed.

465

Postoperative Management

- Three possible situations:
  1. High-risk procedure or situation: Interrogate ICD Prior to D/C from a monitored setting (PACU, ICU)
  2. Monopolar cautery use or lithotripsy: Tell patient to have ICD interrogated within 1 month of D/C from hospital (in person or via telemetry)

*2011 HRS/ASA Consensus Statement

466

HRS/ASA Consensus Statement Post Op Management Rec's

Crossley et al Perioperative Management of Patients With Devices 1131

Table 8 Specific procedures and writing committee recommendations on postoperative CIED evaluation

Procedure	Recommendation
Monopolar electrosurgery	CIED evaluated# within 1 month from procedure unless Table 9 criteria are fulfilled
External cardioversion	CIED evaluated# prior to discharge or transfer from cardiac telemetry
Radiofrequency ablation	CIED evaluated# prior to discharge or transfer from cardiac telemetry
Electroconvulsive therapy	CIED evaluated# within 1 month from procedure unless fulfilling Table 9 criteria
Nerve conduction studies (EMG)	No additional CIED evaluation beyond routine
Ocular procedures	No additional CIED evaluation beyond routine
Therapeutic radiation	CIED evaluated prior to discharge or transfer from cardiac telemetry; remote monitoring optimal; some instances may indicate interrogation after each treatment (see text)
TUNA/TURP	No additional CIED evaluation beyond routine
Hysteroscopic ablation	No additional CIED evaluation beyond routine
Lithotripsy	CIED evaluated# within 1 month from procedure unless fulfilling Table 9 criteria
Endoscopy	No additional CIED evaluation beyond routine
Iontophoresis	No additional CIED evaluation beyond routine
Photodynamic therapy	No additional CIED evaluation beyond routine
Xray/CT scans/mammography	No additional CIED evaluation beyond routine

#This evaluation is intended to reveal electrical reset. Therefore, an interrogation alone is needed. This can be accomplished in person or by remote telemetry.

Heart Rhythm July 2011; 1131

467

Postoperative Management

- Three possible situations:
  1. High-risk procedure or situation: Interrogate ICD Prior to D/C from a monitored setting (PACU, ICU)
  2. Monopolar cautery use or lithotripsy: Tell patient to have ICD interrogated within 1 month of D/C from hospital (in person or via telemetry)
  3. No cautery used: Tell patient to get routine EP follow up

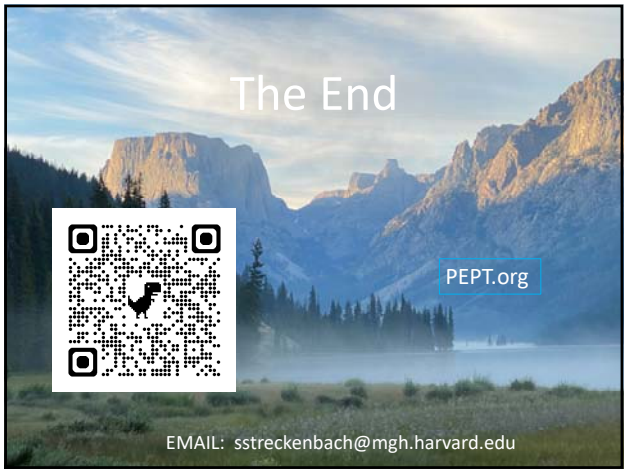
*2011 HRS/ASA Consensus Statement

470

Final Review

1. It takes 2-4 secs of cautery to fool an ICD into believing a patient is in VF—intermittent cautery does not prevent shocks.
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
7. Preop ICD interrogation should be within 3-6 months of the surgery
8. Inhibit ATT if surgery includes cautery above the umbilicus +
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

510



511