Séminaire
Winter Arrhythmia
School
Annual Cardiac Arrhythmia Meeting
Division of Cardiology, University of Toronto

PERIPROCEDURAL MANAGEMENT OF CIED IN UNUSUAL SITUATIONS: ENDOSCOPY AND RADIATION

SUZETTE TURNER RN MS, ANP©

FEBRUARY 11, 2017

14th Annual
Collingwood, Ontario,
February 10 -12, 2017

DISCLOSURES

RELATIONSHIP WITH COMMERCIAL INTERESTS

- NONE

OUTLINE

- ENDOSCOPY/RADIATION (EMI) EFFECTS ON CIED
- INDICATION FOR MAGNET APPLICATION
- GUIDELINE RECOMMENDATIONS
- PROCESS/WORKSHEET

CIED

- PACEMAKER TREATS SLOW RHYTHMS - PACING
- ICD TREATS FAST RHYTHMS - DELIVERING THERAPY + /-PACING

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ENDOSCOPY AND THE CIED PATIENT

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CASE 1

A 78/M

2012- DDD ICD FOR SUSTAINED MMVT

IN 2014, HE BECAME PPM DEPENDENT

HE HAS SEVERE GI DISCOMFORT WITH OCCASIONAL RECTAL BLEEDING

ENDOSCOPY IS SCHEDULED –ELECTROCAUTERY IS ANTICIPATED.

- **WHAT WOULD YOU RECOMMEND FOR DEVICE PROGRAMMING BEFORE THE SURGERY?**

  A. PLACE A MAGNET
  B. PROGRAM TACHYCARDIA DETECTION/THERAPY OFF
  C. PROGRAM TACHYCARDIA DETECTION/THERAPY OFF AND DOO PACING

  D. DO NOTHING

RESPONSE TO NOISE (EMI)

PACEMAKERS

- MAY NOT PACE - **INHIBITION**

DEFIBRILLATORS

- MAY NOT PACE - **INHIBITION**
- MAY SHOCK INAPPROPRIATELY - **TRIGGERING**

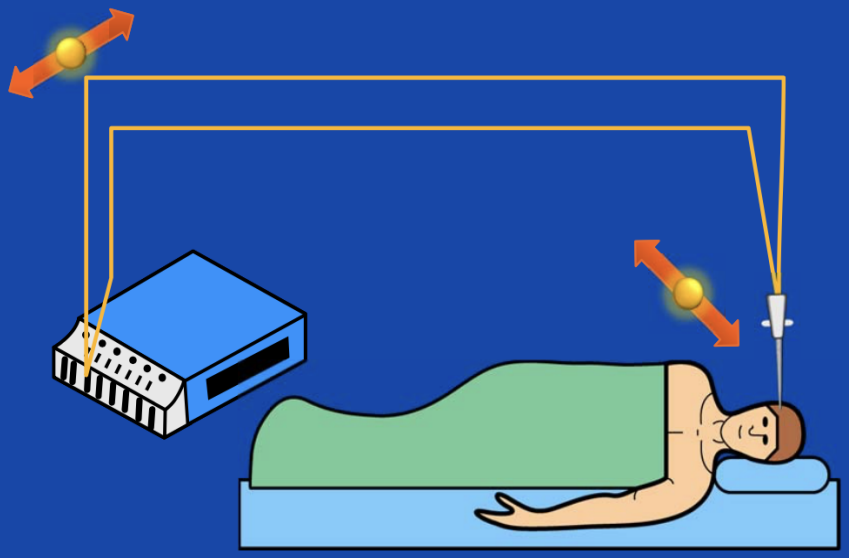
ELECTROCAUTERY AND CIED INTERACTION

- ELECTROSURGERY (100 K-HZ TO 4 M-HZ) - THE APPLICATION OF A HIGH-FREQUENCY ELECTRIC CURRENT TO THE BIOLOGICAL TISSUE AS A MEANS TO CUT, AND COAGULATE

- ELECTROMAGNETIC FIELDS, INTERFERING WITH CIED FUNCTION

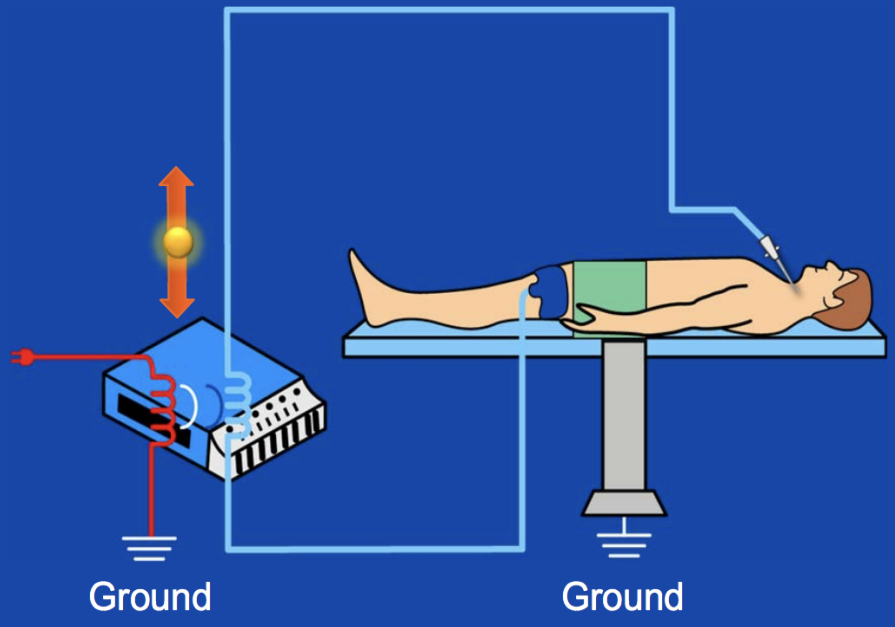
Bipolar

- Both the active electrode and return electrode are at the site of surgery
- No patient return electrode is needed



Monopolar

- Monopolar is most commonly used in the OR
- The active electrode is in the surgical site
- The return electrode is on the patient's body; the current passes through the patient as it completes the circuit



HOW ELECTROCAUTERY AFFECTS CIED

- BIPOLAR ELECTROSURGERY DOES NOT CAUSE EMI UNLESS IT IS APPLIED DIRECTLY TO A CIED
- MONOPOLAR ELECTROSURGERY MAY CAUSE EMI

CONSEQUENCE:

- PPM IS INAPPROPRIATELY INHIBITED
- INAPPROPRIATE SENSING AND TRIGGERING ICD SHOCKS

"ELECTRO MAGNETIC INTERFERENCE"

- **WHAT IS IT?**
  - INTERFERENCE CAUSED BY OUTSIDE SOURCES EG.,ELECTROSURGERY

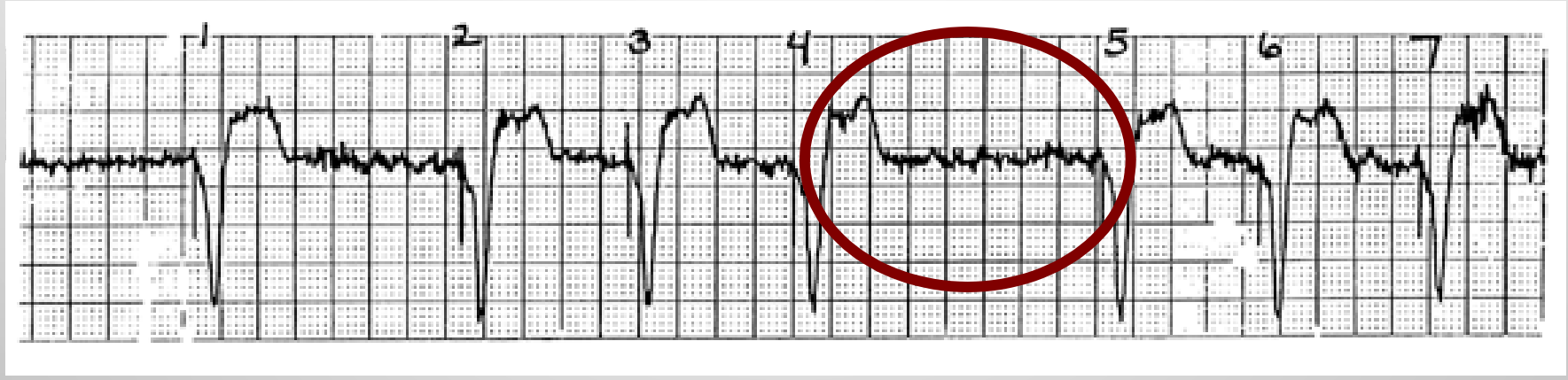
- **POTENTIAL PROBLEMS**
  - OVERSENSING = INHIBITION
  - INAPPROPRIATE DELIVERY OF THERAPY = INAPPROPRIATE SHOCKS

MEDICAL PROCEDURES THAT MAY CAUSE EMI

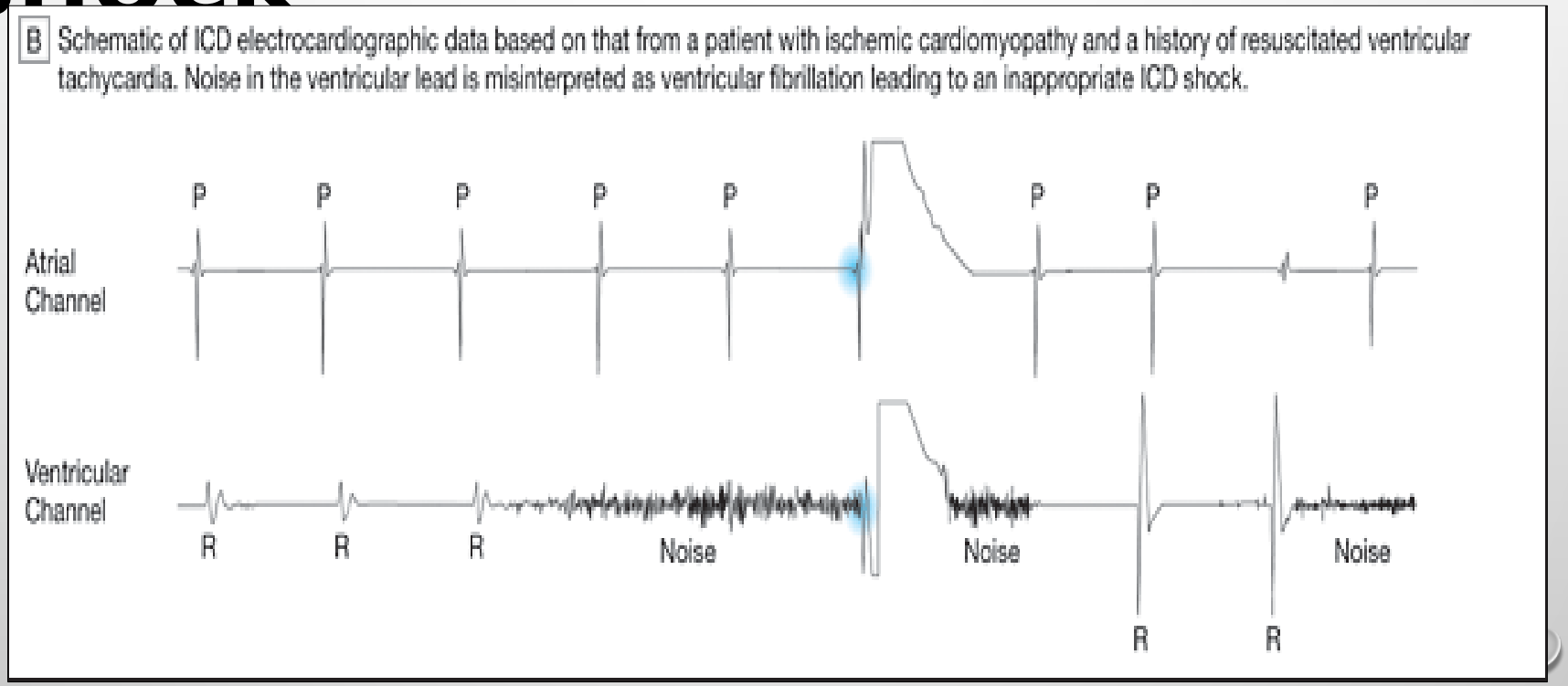
- **PERIOPERATIVE - ELECTROCAUTERY**
- **RADIATION THERAPY**
- TENS (TRANSCUTANEOUS NERVE STIMULATOR) UNIT
- RADIO FREQUENCY ABLATION
- ECT (ELECTROCONVULSIVE THERAPY)
- EXTRACORPOREAL SHOCK WAVE

PACEMAKER: EMI - INHIBITION

- THE SENSING OF AN INAPPROPRIATE SIGNAL
  - CAN BE PHYSIOLOGIC OR NON-PHYSIOLOGIC
  - PACEMAKER INTERPRETS EMI AS A NATIVE RHYTHM AND INHIBITS PACING.



ICD: EMI - INAPPROPRIATE SHOCK



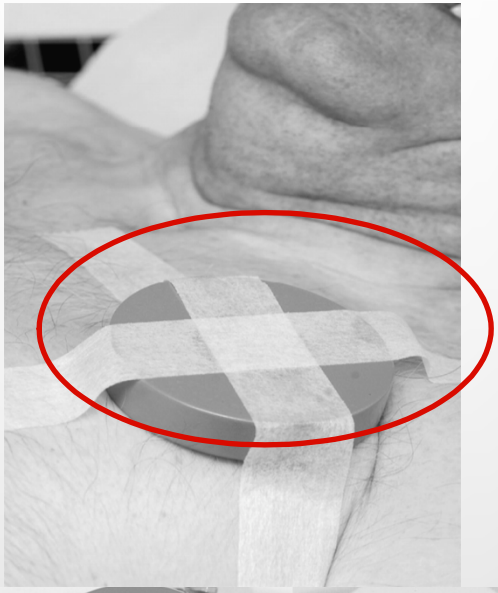
Device interprets EMI “noise” as a fast intrinsic VF rhythm leading to shock.

Gehi, A. K. et al. JAMA 2006;296:2839-2847

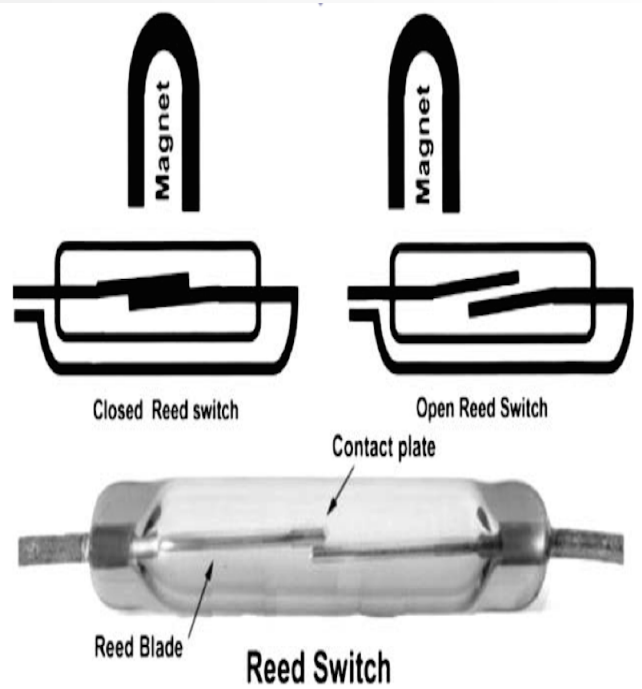
SOLUTIONS TO EMI

- CAUTERY -> SHORT BURST
- BIPOLAR / MULTIPOLAR CURRENT PREFERRED
- IF UNIPOLAR -> AFFIX GROUND PAD TO A LOCATION AVOIDING CURRENT PASSING NEAR OR THROUGH LEADS.

MAGNET APPLICATION



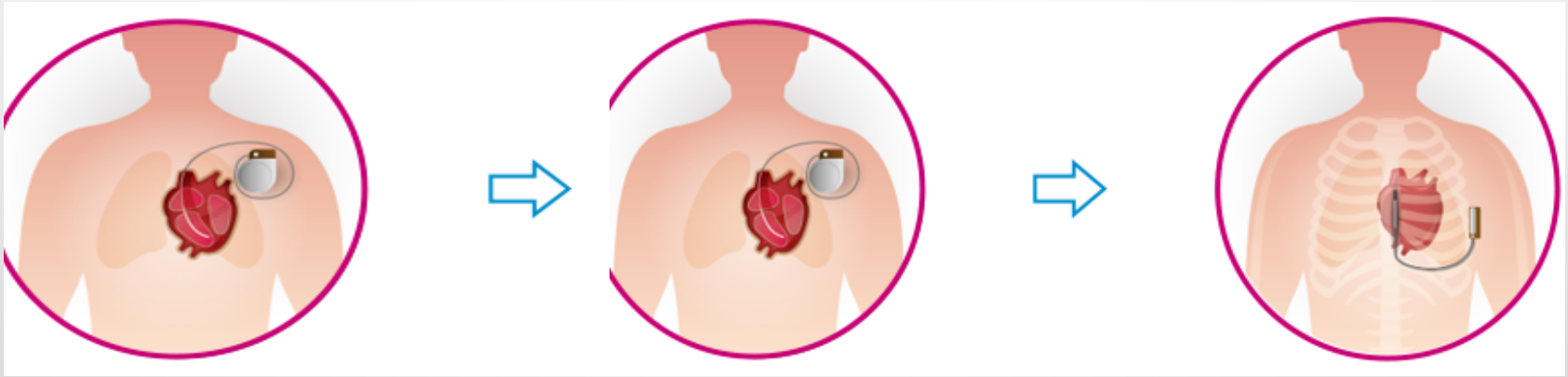
WHAT IS MAGNET EFFECT?



- Reed switch – Open/Close
- Magnet on switches reed switch on and makes sensing function null and void
- Asynchronous mode
- Mandatory pacing mode

Jacob et al.,Eurospace 2011, 13:1222-123

MAGNET APPLICATION



Pacemaker

Transvenous ICD

Subcutaneous ICD

EFFECT OF MAGNET APPLICATION

MAGNET APPLICATION MAY RESULT IN A **TONE OR RINGING** FROM THE DEVICE FOR **10-20 SECONDS**

PPM

- MAGNET INHIBIT SENSING FUNCTION
- PM PACING 85-100 BPM

ICD

- MAGNET DISABLES TACHYARRHYTHMIA DETECTION AND THERAPY
- MAGNET HAS NOT EFFECT ON PACING

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)

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Heart Rhythm, Vol 8, No 7, July 2011

Table 2 Problems that can occur during medical procedures

- Bipolar electrosurgery does not cause EMI unless it is applied directly to a CIED
- EMI from monopolar electrosurgery is the most common problem incurred during surgical procedures
  - Pacemakers may have oversensing and be inhibited when exposed to EMI
  - ICDs and pacemakers with antitachycardia function may be inhibited or may falsely detect arrhythmias when exposed to EMI
  - Device reset occurs infrequently with electrosurgery
  - Electrosurgery applied below the umbilicus is much less likely to cause PM or ICD interference than when applied above the umbilicus
  - Pulse generator damage from electrosurgery can occur, but is uncommon
  - Impedance based rate responsive systems may go to upper rate behavior with electrosurgery exposure
  - Risk mitigation strategies can be effective
  - Keeping the current path away from CIED diminishes the potential for adverse interaction with the CIED
  - Using bipolar electrosurgery whenever possible
  - Minimizing the length of monopolar electrosurgery bursts to 5 seconds or less
- Lead tissue interface damage from external current is considered an unlikely risk
- Cardioversion can cause reset of the CIED
- RF ablation can cause all of the interactions that monopolar electrosurgery can cause but may have a more significant risk profile due to the prolonged exposure to current
- Therapeutic radiation is the most likely source of EMI to result in CIED reset
- ECT has rarely been reported to cause EMI during the stimulus, but the more common problem with EMI may be the extreme sinus

- **GI procedures that use electrosurgery may result in interference**

ORIGINAL ARTICLE

Clin Endosc. 2016;49:176-181
http://dx.doi.org/10.5946/ce.2015.023
Print ISSN 2234-2400 • On-line ISSN 2234-2443

CLINICAL ENDOSCOPY

Open Access

Endoscopic Electrosurgery in Patients with Cardiac Implantable Electronic Devices

Myong Ki Baeg[1], Sang-Woo Kim[1], Sun-Hye Ko[2], Yeon Bum Lee[1], Seawon Hwang[2], Bong-Woo Lee[2], Hye Jin Choi[2],

CLINICAL ENDOSCOPY

Table 1. Demographic Characteristics of Patients with Cardiac Implanted Electronic Devices Undergoing Endoscopic Electrosurgery

Characteristic	Total	Pacemaker	ICD
No. of patients	49	43	6
No. of procedures	59	50	9
Age, yr	69.1±9.1	71.1±8.2	57.7±4.4
Male sex	39	30	6
Reason for device implantation			
Sick sinus syndrome	32	32	0
Complete atrioventricular block	8	8	0
Second degree atrioventricular block	5	5	0
Atrial fibrillation with slow ventricular response	2	2	0
Junctional bradycardia	2	2	0
Idiopathic ventricular tachycardia	8	0	8
Brugada syndrome	1	0	1
Unknown	1	1	0
Time from device implantation to endoscopic surgery, day	1,844±1,640	2,006±1,722	982±653
Type of endoscopic electrosurgery			
Colon snare polypectomy	44	35	9
Colon ESD	1	1	0
Gastric snare polypectomy	1	1	0
Gastric ESD	5	5	0
ERCP with EST	8	8	0
Admission status			

Time to cardiology outpatient clinic visit, day	46±47 (53/59[a])	44±46 (44)	59±54 (9)
Time to initial electrical follow-up, day	111±119 (55/59[b])	103±122 (46)	154±92 (9)
Type of initial electrical follow-up[c]			
Electrocardiogram	31	28	3
24-Hour Holter monitoring	9	6	3
Pacemaker interrogation	23	17	6
Not done	5	5	0
Time to next pacemaker interrogation after endoscopic electrosurgery	226±222 (55)	242±240 (46)	173±113 (9)
Postprocedure changes noted on electrical follow-up	2	2	0

Values are presented as mean±SD (number). Differences between outpatient visit and electrical follow-ups are due to some electrical follow-ups being performed by departments other than cardiology.
ICD, implantable cardioverter-defibrillator.
[a]Two follow-up losses, two followed up by the oncology department for underlying malignancies, one unable to visit the hospital as the patient was staying at a facility for the disabled and one whose follow-up date had not come up; [b]Two follow-up losses, one who visited the cardiology outpatient clinic but was deemed asymptomatic and scheduled for regular pacemaker interrogation at a later date and one who has not yet visited the cardiology outpatient clinic; [c]Some electrical follow-up types were carried out simultaneously.

- CONCLUSIONS: STUDY REPORTS NO ADVERSE EVENTS.

CLIN ENDOSC 2016;49:176-181

Communication from the Technology Assessment Committee

TECHNOLOGY STATUS EVALUATION REPORT

AMERICAN SOCIETY FOR GASTROINTESTINAL ENDOSCOPY ASGE

Endoscopy in patients with implanted electronic devices

REVIEW ARTICLE

An update on the management of implanted cardiac devices during electrosurgical procedures (CME)

Parth J. Parekh, MD,[1] Ross C. Buerlein, MD,[1] Rouzbeh Shams, MD,[1] John Herre, MD, FACC, FACP,[2,4] David A. Johnson, MD, FACG, FASGE[3]

Norfolk, Virginia, USA

ASGE SUGGESTIONS

1. DETERMINE PRESENCE AND TYPE OF DEVICE AND PATIENT'S PACER DEPENDENCY.
2. PULSE OXIMETRY AND ECG MONITORING DURING THE PROCEDURE.
3. USE BIPOLAR OR MULTIPOLAR ELECTROCAUTERY.
4. LIMIT BURSTS TO 5 SECONDS OR LESS.
5. GROUNDING PAD SHOULD BE AT LEAST 15CM FROM DEVICE.

CASE 1

- *A 78/M*
- *2012, DDD ICD FOR SUSTAINED MMVT. IN 2014, PPM DEPENDENT*
- HE HAS SEVERE GI DISCOMFORT WITH OCCASIONAL RECTAL BLEEDING. ENDOSCOPY IS SCHEDULED.
- **WHAT WOULD YOU RECOMMEND FOR DEVICE PROGRAMMING BEFORE THE SURGERY?**

A. PLACE A MAGNET
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C. PROGRAM TACHYCARDIA DETECTION/THERAPY OFF AND DOO PACING
D. DO NOTHING

Arrhythmia Service Department Cardiac Device Endoscopy Procedure

Worksheet not a chart copy

Device Information (Completed by Endoscopy)

☐ Pacemaker ☐ Defibrillator

Location: Chest RT☐ LT☐ Abdomen☐ LT Axillary☐

Patients Device Follow Up Clinic: _____

Endoscopy Procedure:
☐ Colonoscopy ☐Colonoscopy + Polyp Removal ☐ Other: _____
Date / Time / Location of Procedure:
_____

Arrhythmia Service Recommendations During Endoscopy Procedure (Completed by Arrhythmia Nurse Practitioner/Physician)

Implant Date: _____
Manufacturer / Model: _____
Device programmed settings: _____

- ☐ Pacemaker dependent
- ☐ Pacemaker not dependent
- ☐ Pulse oximetry during procedure
- ☐ Magnet application (by RN/Physician)
- ☐ Reprogramming of cardiac device prior to procedure
- ☐ Device check at start and end of treatment
- ☐ Device check at end of procedure
- ☐ No device check

Additional Recommendations: _____
_____
_____

Return completed form via **Fax** to Arrhythmia Service Department: **416 - 480 - 5740**

Arrhythmia Provider

Name: _____ Date: _____

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RADIATION AND THE CIED PATIENT

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CASE 2

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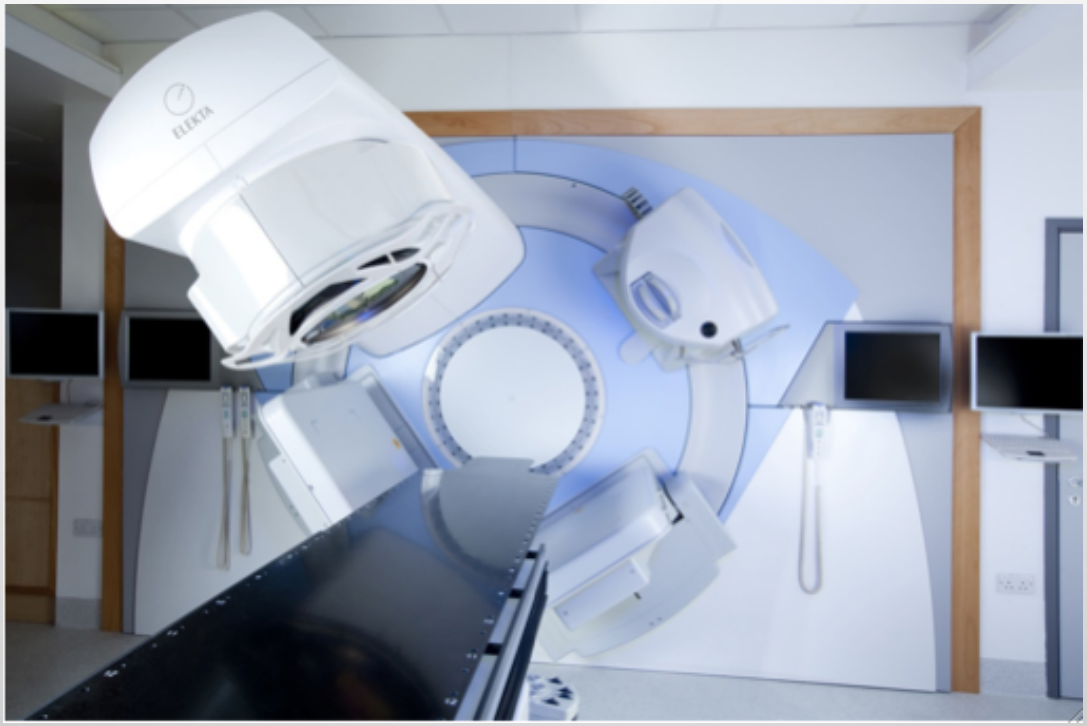
- NOW HAS BLADDER CA FOR RADIATION TREATMENT, 5 FRACTIONS, 6MV, 200CGY
- **WHAT WOULD YOU RECOMMEND FOR DEVICE PROGRAMMING BEFORE THE RADIATION?**

A. PLACE A MAGNET
B. CHECK PACEMAKER DAILY AFTER EACH TREATMENT
C. PROGRAM PACEMAKER TO VOO
D. CHECK PACEMAKER PRE AND POST RADIATION

LINAC- A LINEAR ACCELERATOR



WHAT IS RADIATION TREATMENT?

- NONINVASIVE LOCAL TREATMENT USING IONIZING RADIATION DELIVERED TO EITHER MALIGNANT OR NONMALIGNANT TUMOR
- BENEFITS INCLUDE CONFINEMENT OF TREATMENT SIDE EFFECTS, PRESERVATION OF FUNCTION, AND BETTER COSMETIC RESULTS THAN SURGERY
- ALSO WIDELY USED IN PALLIATIVE TREATMENTS WITH 40-50% TREATMENT ADMINISTERED WITH PALLIATIVE INTENT

(Washington & Lever; Kirkbridge, 1999)

RADIATION TREATMENT EFFECTS

	Potential error	Cardiac pacemaker	ICD
Ionizing radiation	Altered stimulation (amplitude, frequency)	X	x
	Altered sensing (over-/under sensing)	X	x
	Inhibition of stimulation (pause, asystole)	X	x
	Change in operational mode (incl. asynchronous stimulation)	X	x
	Battery depletion (ERI-exchange indicator)	X	x
	Altered electrode sensing (impedance)	X	x
	Inhibition of antitachyarrhythmia therapy		x
	Altered (reduced) shock energy		x
	Prolonged detection and charging intervals		x
	Inadequate (shock) therapy		x
	Loss of telemetry or programming capabilities	x	x
	Reset in default setting (fallback mode)	x	x
	Loss of function	x	x
Electromagnetic interference	Altered sensing (over-/under sensing)	x	x
	Inhibition of stimulation (pause, asystole)	x	x
	Reed-switch interaction (asynchronous stimulation)	x	x
	Atrial-triggered fast ventricular pacing	x	x
	Inhibition of antitachyarrhythmia therapy		x
	Inadequate (shock) therapy		x
	Reset/reprogramming of device	x	x

Croshaw R, Kim Y, Lappinen E et al (2011. Ann Surg Oncol 18:3500–3505

RADIATION TREATMENT EFFECTS

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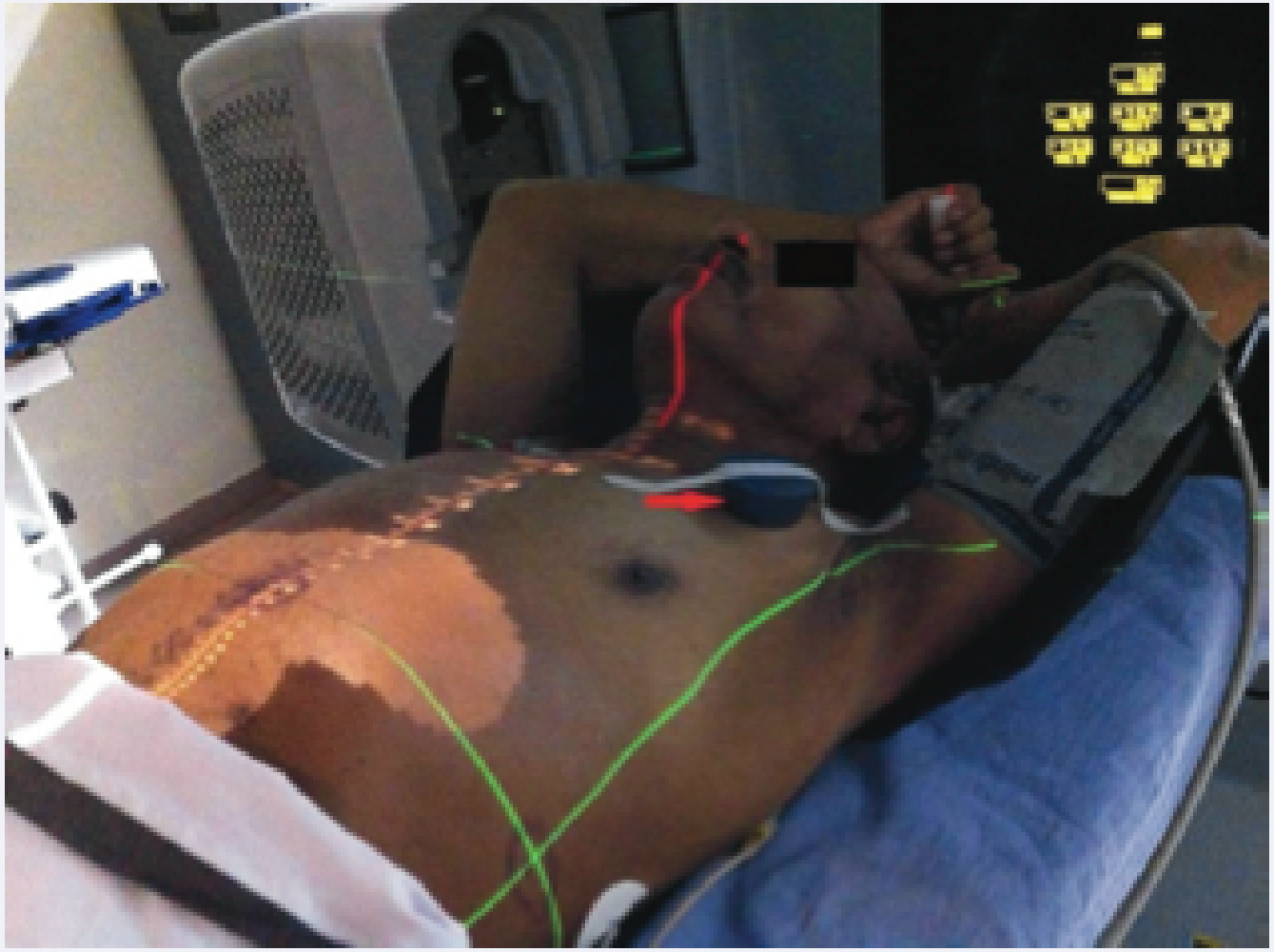
	Inhibition of stimulation (pause, asystole)	x	x
	Reed-switch interaction (asynchronous stimulation)	x	x
	Atrial-triggered fast ventricular pacing	x	x
	Inhibition of antitachyarrhythmia therapy		x
	Inadequate (shock) therapy		x
	Reset/reprogramming of device	x	x

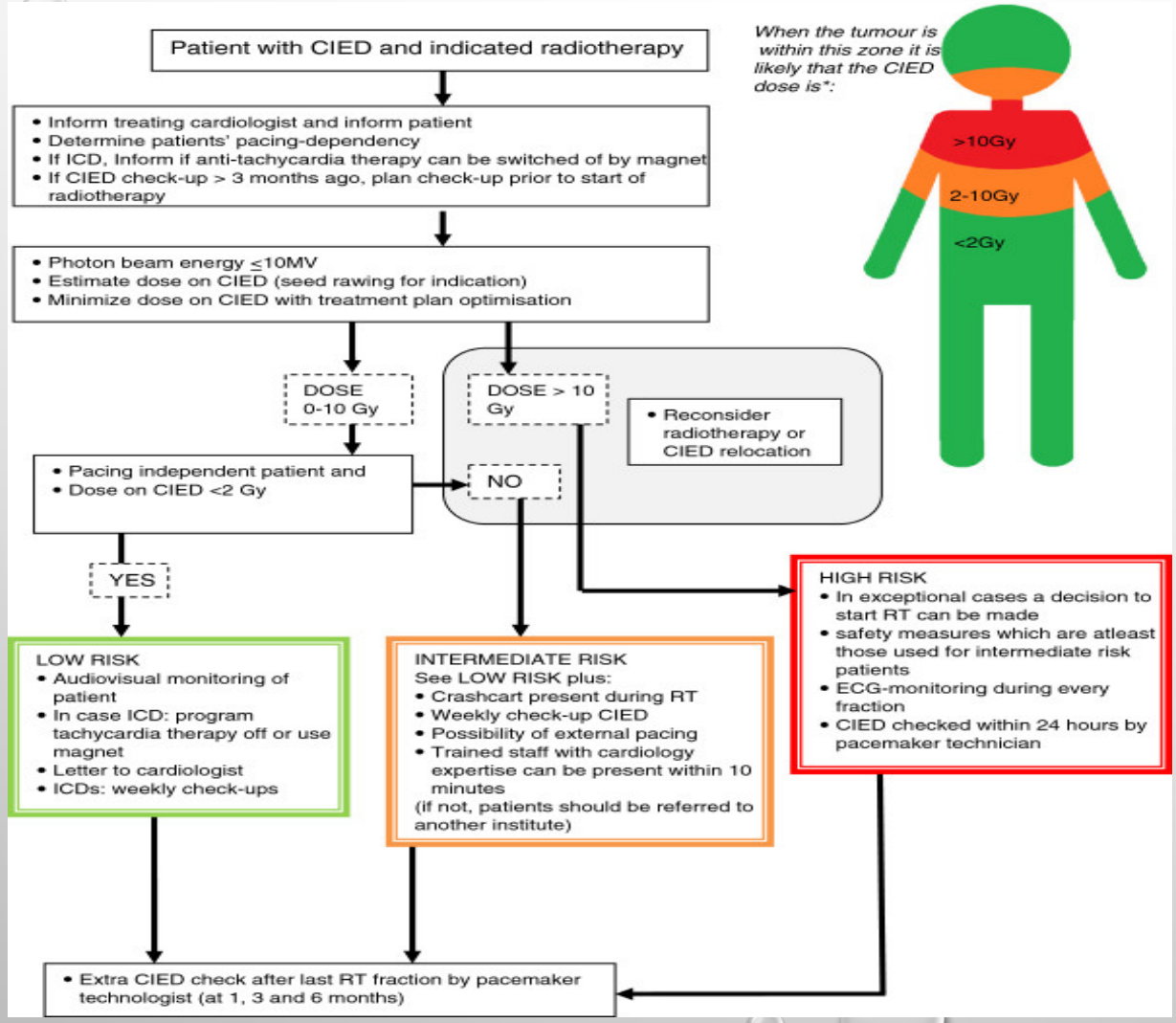
- Can affect programmable parameters of the ICD/PPM
- Initiation of unintended operations
- The degree of damage is unpredictable

Croshaw R, Kim Y, Lappinen E et al (2011. Ann Surg Oncol 18:3500–3505

MAGNET PLACEMENT

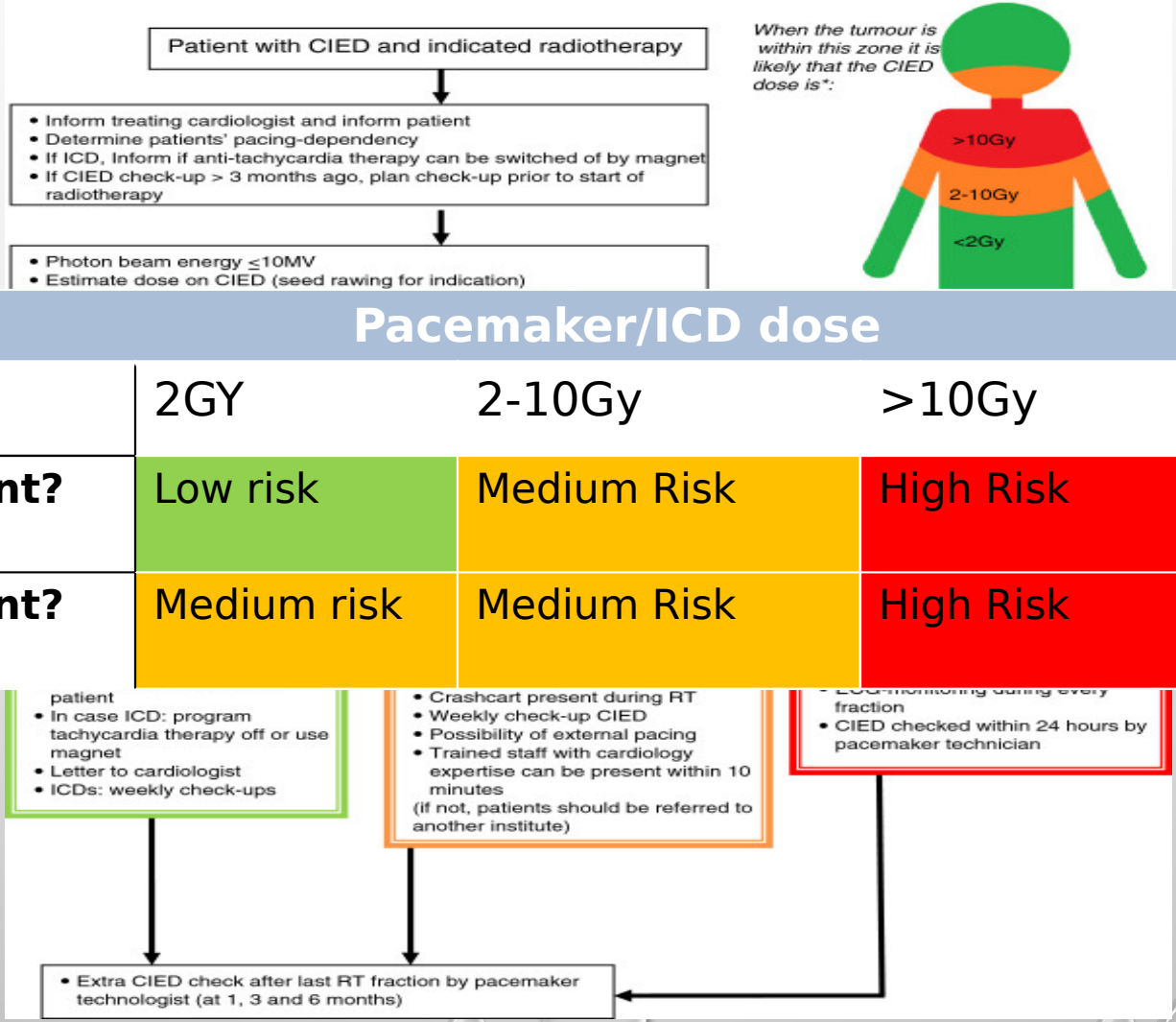


HURKMANS



Hurkmans CW et al. (2012). Oncol 7: 198.

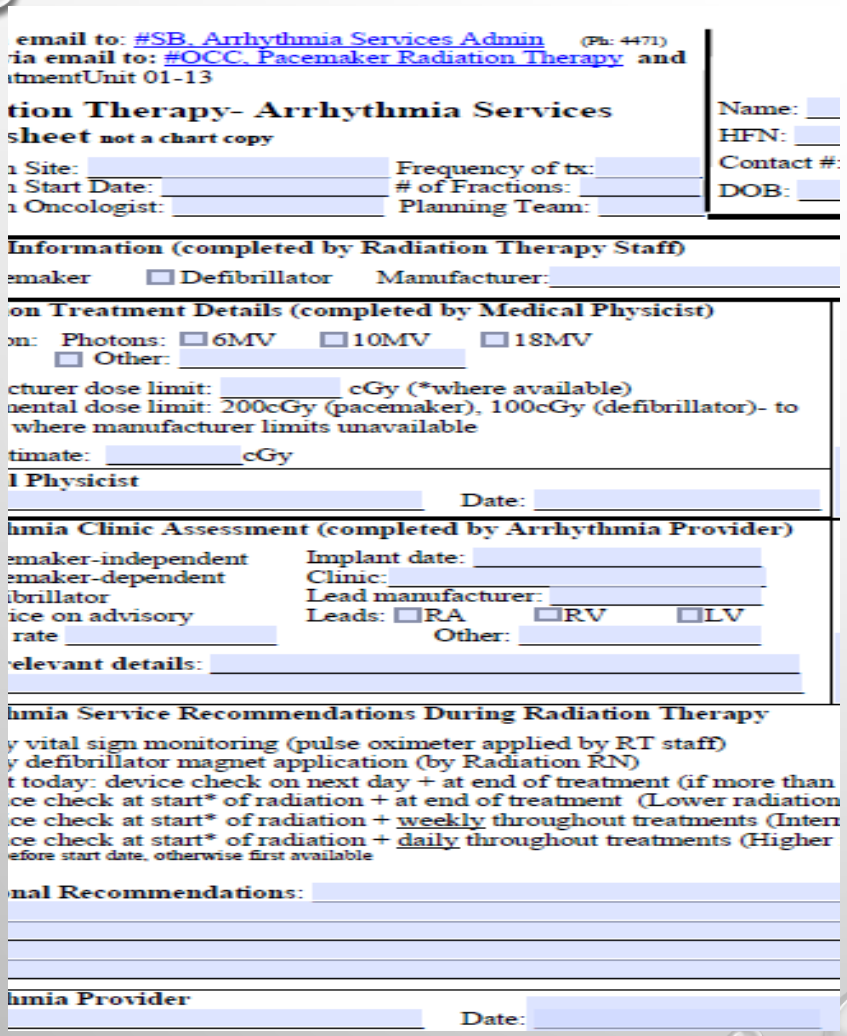
HURKMANS



Pacemaker/ICD dose			
	2GY	2-10Gy	>10Gy
Pace dependent? No	Low risk	Medium Risk	High Risk
Pace dependent? Yes	Medium risk	Medium Risk	High Risk

Hurkmans CW et al. (2012). Radiation Oncol 7: 198.

WORKSHEET



email to: #SB. Arrhythmia Services Admin (Ph: 4471)
ia email to: #OCC. Pacemaker Radiation Therapy and
tmentUnit 01-13

tion Therapy- Arrhythmia Services
sheet not a chart copy

Name:
HFN:
Contact #:
DOB:

n Site: Frequency of tx:
n Start Date: # of Fractions:
n Oncologist: Planning Team:

Information (completed by Radiation Therapy Staff)

emaker ☐ Defibrillator Manufacturer:

on Treatment Details (completed by Medical Physicist)

n: Photons: ☐ 6MV ☐ 10MV ☐ 18MV
☐ Other:

cturer dose limit: cGy (*where available)
ental dose limit: 200cGy (pacemaker), 100cGy (defibrillator)- to
where manufacturer limits unavailable

timate: cGy

l Physicist

Date:

hmia Clinic Assessment (completed by Arrhythmia Provider)

emaker-independent
emaker-dependent
ibrillator
ice on advisory
rate

Implant date:
Clinic:
Lead manufacturer:
Leads: ☐ RA ☐ RV ☐ LV
Other:

elevant details:

hmia Service Recommendations During Radiation Therapy

y vital sign monitoring (pulse oximeter applied by RT staff)
y defibrillator magnet application (by Radiation RN)
t today: device check on next day + at end of treatment (if more than
ce check at start* of radiation + at end of treatment (Lower radiation
ce check at start* of radiation + weekly throughout treatments (Inter
ce check at start* of radiation + daily throughout treatments (Higher
efore start date, otherwise first available

nal Recommendations:

hmia Provider

Date:

Site:

Arrhythmia Service Recommendations during radiation treatments:

YES/NO - Daily vital sign monitoring (pulse oximeter applied by RT staff)

YES/NO - Daily defibrillator magnet application (by Radiation RN)

YES/NO - Treat today: device check on next day + at end of treatment (if more than one fraction)}

YES/NO - Device check at start of radiation + at end of treatment (Lower radiation AND clinical risk)

YES/NO - Device check at start of radiation + weekly throughout treatments (Intermediate risk in either category)

YES/NO - Device check at start* of radiation + daily throughout treatments (Higher risk in either category)

Additional Recommendations:

SUMMARY OF PROCESS

- Co-ordinated effort between, radiation therapy, physics, cardiology, radiation oncology, nursing and the patient
- Identify the manufacturer, dependency area and dose of treatment
- Check device-capture, sensing thresholds and battery status
- **Flags** if CIED is located in treatment zone
- Individualize

CASE 2

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THANK YOU

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REFERENCES

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CIED MANUFACTURERS

Recommendation	Biotronik[125]	Boston Scientific[123]	Medtronic[122]	St. Jude Medical[124]
Maximal PM dose	2 Gy	No safe dose (2 Gy as a reference)	5 Gy	No safe dose
Maximal ICD dose	2 Gy	No safe dose (2 Gy as a reference)	1-5 Gy depending on the model	No safe dose
Maximal beam energy	<10 MV	Not stated	≤10 MV	Not stated
Device checks				
Before the RT course	Yes	Specific to each patient	Not stated	Not stated
During the RT course	Not stated	Specific to each patient	Yes (after each fraction if the recommended safe dose is exceeded)	Yes (a detailed evaluation once or twice during the RT course in PM-dependent patients)
After the RT course	Yes, including a supplementary follow-up shortly after the RT	Yes, including subsequent close monitoring of the device function	Yes (intensified follow-up schedule)	Yes
Inactivation of antitachycardia therapies	Yes	Yes	Yes	Yes
Lead shielding of the device	Yes	All available shielding options, including both internal shielding within the LINAC and external shielding of the patient	No (ineffective against neutrons)	Not stated (reduction in the device dose is recommended)
Heart rhythm monitoring during RT	Yes	As determined most appropriate by the physician team	Not stated	Yes

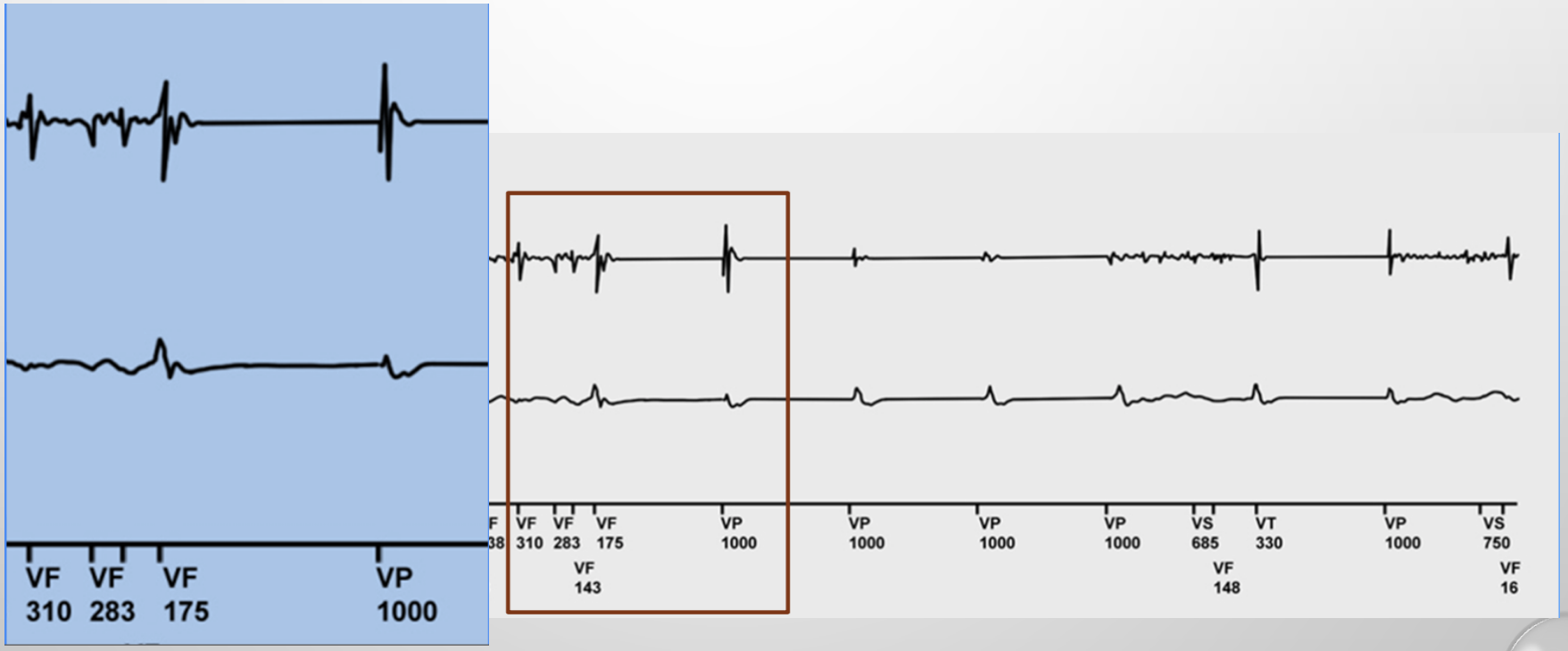
Gy = gray; ICD = implantable cardioverter defibrillator; LINAC = linear accelerator; MV = megavolt; PM = pacemaker; RT = radiotherapy.

Zaremba , 2015

EMI Detection During Surgeries (Mayo Prospective Study)

Surgical areas	No.	ICD detection, no. (%)
Head, neck	11	3 (27)
Shoulder/upper extremity	26	2 (8)
Thorax (non-cardiac)	11	5 (45)
Abdomen, pelvic	37	1 (3)
Back, spine	7	0 (0)
Hip, lower extremity	28	0 (0)
Total	**120**	**11 (9)**

CAUTERY DURING ENDOSCOPY



RADIATION PLANNING AND TREATMENT PROCESS

- THE ABSORBED DOSE OF RADIATION MEASURED IN GRAY (GY) AND CALCULATED AS ONE JOULE (J) OF ENERGY ABSORBED PER KG
- TREATMENT ADMINISTERED FROM ONE DAY – 8 WKS OF DAILY TX OR FRACTIONS
- CONVENTIONAL FRACTIONATIONS- DAILY DOSES OF 1.8- 2GY FOR RADICALLY OR CURATIVELY TREATED PATIENTS
- HIGHER DOSES (HYPERFRACTIONATION) USED IN PALLIATIVE CASES TO DECREASE TX TIME

Ling et al (2010) *Radiotherapy and Oncology, 95(3), 261-268.*

CAPSULE ENDOSCOPY

…THE WRITING COMMITTEE RECOMMENDS NO SPECIFIC INTERVENTIONS ON THE PACEMAKER OR DEFIBRILLATOR. HOWEVER, WE DO NOTE THAT THE MANUFACTURER OF THIS DEVICE STATES THAT ITS USE IS CONTRAINDICATED IN PATIENTS WITH PACEMAKERS AND ICDS.

RADIATION VARIABLES RELATED TO FAILURE

- CUMULATIVE DOSE
- NEUTRONS
- ENERGY
  - MEV (FOR SUPERFICIAL CANCERS- UNPREDICTABLE, SCATTERED ENERGY
  - MV (NORMALLY USED)
  - KV (ORTHOVOLTAGE FOR SKIN)
- EMI

RADIATION POTENTIAL EFFECTS

Potential Effect	Pacemakers	ICD
Permanent damage	Rare	Rare
Temporary loss of sensing	Uncommon	Uncommon
Temporary loss of capture	Uncommon	Uncommon
Temporary increased sensor rate	Common	Common
Temporary rate change	Uncommon	Uncommon
Pulse generator damage	Uncommon	Uncommon
Damage of the lead	Uncommon	Uncommon

Crossley et al (2011 HRS)

HEART RHYTHM CONSENSUS STATEMENT 2011

6.2.5. Therapeutic radiation

The application of external beam ionizing radiation represents one of the greatest risks for reversion to a safety mode or CIED malfunction. Although in most cases every effort is made to focus the beam away from the device, scatter particles including neutrons and protons (regardless of the location of the beam) can cause the CIED to enter a backup safety mode. These instances can pose a risk for inappropriate ICD shocks (given lower rate cut offs) and loss of cardiac resynchronization pacing until the device has been reprogrammed to its original settings. It is often the case that patients undergoing therapeutic radiation receive several cycles of treatment over the course of weeks. Theoretically, each application of radiation can render the device into a backup safety mode, thereby requiring frequent evaluation of the device. Given these issues, the writing committee

of the device. Given these issues, the writing committee recommends that all individuals anticipating therapeutic radiation be enrolled in a remote monitoring system if possible. In certain high-risk cases such as direct beam to the chest or high-energy photon irradiation, CIEDs should be evaluated within 24 hours of each treatment. In other pa-

patient needs to come to the device clinic for interrogation. If neither of these approaches is possible, it is necessary to have the device interrogated immediately after each treatment prior to discharge or transfer from a cardiac telemetry setting.

SUMMARY OF SUGGESTIONS

1. MONITOR PATIENT DURING PROCEDURE WITH BOTH TELEMETRY AND SATURATION MONITOR.
2. HAVE A CRASH CART AVAILABLE WITH PERSONNEL ABLE TO USE IT.
3. HAVE A MAGNET AVAILABLE AND PERSONNEL EDUCATED HOW TO APPLY.
4. ANY PATIENT WITH A SHOCK OR ARRHYTHMIA SHOULD BE TRANSFERRED TO A TELEMETRY-MONITORED SETTING.
5. IF USING CAUTERY, USE BIPOLAR, SHORT BURSTS, APPLY RETURN PAD TO LOWER ABDOMEN.
6. AVOID PROXIMITY OF ELECTROCAUTERY TO GENERATOR OR LEADS