2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices

Julia H. Indik, MD, PhD, FHRS, FACC, FAHA (Chair),[1] J. Rod Gimbel, MD (Vice-Chair),[2] Haruhiko Abe, MD,[3,*] Ricardo Alkmim-Teixeira, MD, PhD,[4,‡] Ulrika Birgersdotter-Green, MD, FHRS,[5] Geoffrey D. Clarke, PhD, FACR, FAAPM,[6,§] Timm-Michael L. Dickfeld, MD, PhD,[7] Jerry W. Froelich, MD, FACR,[8,¶] Jonathan Grant, MD,[9,#] David L. Hayes, MD, FHRS,[10] Hein Heidbuchel, MD, PhD, FESC,[11,**] Salim F. Idriss, MD, PhD, FHRS, FACC,[12,‡‡] Emanuel Kanal, MD, FACR, FISMRM, MRMD,[13] Rachel Lampert, MD, FHRS,[14] Christian E. Machado, MD, FHRS, CCDS,[15] John M. Mandrola, MD,[16] Saman Nazarian, MD, PhD, FHRS,[17] Kristen K. Patton, MD,[18] Marc A. Rozner, PhD, MD, CCDS,[19,†] Robert J. Russo, MD, PhD, FACC,[20] Win-Kuang Shen, MD, FHRS,[21,§§] Jerold S. Shinbane, MD, FHRS,[22] Wee Siong Teo, MBBS (NUS), FRCP (Edin), FHRS,[23,¶¶] William Uribe, MD, FHRS,[24,##] Atul Verma, MD, FRCPC, FHRS,[25] Bruce L. Wilkoff, MD, FHRS, CCDS,[26] Pamela K. Woodard, MD, FACR, FAHA[27,***]

Document Reviewers: Luis Aguinaga, MD; Timothy S.E. Albert, MD, FACC; Peter F. Aziz, MD, FHRS; Alec Block, MD; Peter Brady, MB, ChB, MD; Mina Chung, MD, FACC; Michael Dominello, DO; Andrew E. Epstein, MD, FACC; Susan P. Etheridge, MD, FHRS; Paul A. Friedman, MD; Thomas C. Gerber, MD, PhD, FAHA; Robert H. Helm, MD; Ricardo Kuniyoshi, MD, PhD; Martin J. LaPage, MD, MS, FHRS; C.P. Lau, MD; Harold Litt, MD; Lluis Mont, MD; Takashi Nitta, MD; Jack Rickard, MD, MPH; Frank Rybicki, MD, PhD; Wenyin Shi, MD, PhD; Christian Sticherling, MD; Andrew Taylor, MD; Mark Trombetta, MD, FACR; Paul J. Wang, MD, FHRS; L. Samuel Wann, MD, MACC; Ying Xiao, PhD

From the [1]University of Arizona, Sarver Heart Center, Tucson, AZ, [2]Case Western Reserve University, Cleveland, OH, [3]Department of Heart Rhythm Management, University of Occupational and Environmental Health, Kitakyushu, Japan, [4]Heart Institute-InCor, São Paulo University Medical School, São Paulo, Brazil; Sapucaí Valley University-UNIVÁS and Hospital Renascentista, Pouso Alegre, Minas Gerais, Brazil,

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ABBREVIATIONS **CIED** = cardiac implantable electronic device; **COR** = Class of Recommendation; **CRT** = cardiac resynchronization therapy; **CRT-D** = cardiac resynchronization therapy with implantable cardioverter-defibrillator; **CRT-P** = cardiac resynchronization therapy-pacemaker; **CT** = computed tomography; **dB/dt** = time-varying magnetic field; **DFT** = defibrillation threshold test; **ECG** = electrocardiogram; **EMI** = electromagnetic interference; **EO** = expert opinion; **EP** = electrophysiology; **ERI** = elective replacement interval; **FDA** = Food and Drug Administration; **Gy** = Gray, a measurement of absorbed radiation dose; **HR** = heart rate; **ICD** = implantable cardioverter defibrillator; **ILR** = implantable loop recorder; **LD** = limited data; **LINAC** = linear accelerator; **LOE** = Level of Evidence; **MR** = magnetic resonance; **MRI** = magnetic resonance imaging; **ms** = milliseconds; **MV** = megavolt; **mV** = millivolts; **NMR** = nuclear magnetic resonance; **NR** = nonrandomized; **PM** = pacemaker; **POR** = power-on reset; **R** = randomized; **RCT** = randomized controlled trial; **RF** = radiofrequency; **RT** = radiation treatment; **SAR** = specific absorption rate; **T** = Tesla, a measurement of magnetic field strength; **V** = volts; **VT** = ventricular tachycardia (Heart Rhythm 2017;■:e1–e57)

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[5]UC San Diego Health System, La Jolla, CA, [6]University of Texas Health Science Center, San Antonio, TX, [7]University of Maryland Medical System, Baltimore, MD, [8]Department of Radiology, University of Minnesota, Minneapolis, MN, [9]Southeast Radiation Oncology Group, Levine Cancer Institute, Carolinas HealthCare System, Charlotte, NC; Department of Radiation Oncology, Intermountain Healthcare, Salt Lake City, UT, [10]Mayo Clinic, Division of Cardiovascular Diseases, Rochester, MN, [11]Antwerp University, Antwerp, Belgium, [12]Duke University Medical Center, Durham, NC, [13]University of Pittsburgh Medical Center, Pittsburgh, PA, [14]Yale University School of Medicine, New Haven, CT, [15]Michigan State University, East Lansing, MI, [16]Baptist Health Louisville, Louisville, KY, [17]University of Pennsylvania, Philadelphia, PA, [18]University of Washington, Seattle, WA, [19]University of Texas MD Anderson Cancer Center, Houston, TX, [20]The Scripps Research Institute and the La Jolla Cardiovascular Research Institute, La Jolla, CA, [21]Mayo Clinic, Phoenix, AZ, [22]Division of Cardiovascular Medicine, Keck School of Medicine of the University of Southern California, Los Angeles, CA, [23]National Heart Centre Singapore, Singapore, [24]CES Cardiología and Centros Especializados de San Vicente Fundación, Medellin, Colombia, [25]Southlake Regional Health Centre, Toronto, ON, Canada, [26]Cleveland Clinic, Cleveland, OH, and [27]Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, MO.

[†]Deceased. See In Memoriam at the end of this document
[*]Representative of the Japanese Heart Rhythm Society (JHRS)
[‡]Representative of the Brazilian Society of Cardiac Arrhythmias (SOBRAC)
[§]Representative of the Council of Affiliated Regional Radiation Oncology Societies (CARROS)
[¶]Representative of the American College of Radiology (ACR)
[#]Representative of the American Society for Radiation Oncology (ASTRO)
[**]Representative of the European Heart Rhythm Association (EHRA)
[‡‡]Representative of the Pediatric and Congenital Electrophysiology Society (PACES)
[§§]Representative of the American College of Cardiology (ACC)
[¶¶]Representative of the Asia Pacific Heart Rhythm Society (APHRS)
[##]Representative of the Latin American Society of Cardiac Stimulation and Electrophysiology (SOLAECE)
[***]Representative of the American Heart Association (AHA)

TABLE OF CONTENTS

Section I: Introduction and Methodology

This document is intended to help cardiologists, radiologists, radiation oncologists, and other health care professionals involved in the care of adult and pediatric patients with cardiac implantable electronic devices (CIEDs) who are to undergo magnetic resonance imaging (MRI), computed tomography (CT), and/or radiation treatment. We also address the safety of employees with CIEDs who might come into an MRI environment. Our objective is to delineate practical recommendations in appropriate detail for health care providers of various backgrounds for the management of patients with CIEDs so they can undergo imaging and treatments in a manner that balances benefit and risk, while recognizing that risk cannot be eliminated.

This international consensus statement was written by experts in the field chosen by the Heart Rhythm Society (HRS) and collaborating societies. Eleven societies collaborated in this effort: American Heart Association (AHA), American College of Cardiology (ACC), American College of Radiology (ACR), Asia Pacific Heart Rhythm Society (APHRS), American Society for Radiation Oncology (ASTRO), Council of Affiliated Regional Radiation Oncology Societies (CARROS), European Heart Rhythm Association (EHRA), Japanese Heart Rhythm Society (JHRS), Pediatric and Congenital Electrophysiology Society (PACES), Brazilian Society of Cardiac Arrhythmias (SOBRAC), and the Latin American Society of Cardiac Stimulation and Electrophysiology (SOLAECE).

Some areas are outside the scope of this document. First, in the health care environment, reimbursement by commercial insurance or Medicare can become integral to the decision