MASSACHUSETTS GENERAL HOSPITAL
DEPARTMENT OF RADIATION ONCOLOGY
GENERAL POLICY
CARDIAC PACEMAKERS AND IMPLANTABLE CARDIOVERTER DEFIBRILLATORS RECEIVING PHOTON RADIATION TREATMENT

Title: Treatment & Monitoring of Patients with Implanted Cardiac Devices

Level of Personnel: MD, Resident, NP, RN, RTT, Physics

Designated Clinical Areas: Radiation Oncology Clinical areas:
MGH The Clark Center for Radiation Oncology
MGH Radiation Oncology at Emerson Hospital
MGH Radiation Oncology at Newton Wellesley Hospital

Applicable Policy Statement:
There is a potential for life threatening malfunction to implanted cardiac devices (cardiac pacemakers (CP) and implanted cardiac defibrillators (ICD) due to electromagnetic interference (EMI) and ionizing radiation. The risk of radiation effects on the functionality of implanted cardiac devices increases with the cumulative dose. Direct exposure of implanted cardiac devices to radiation can lead to device failure or malfunction.

Definitions:
Cardiac Implantable Electronic Device (CIED)

1) Implanted Cardiac Pacemaker (ICP)/ Permanent Pacemakers (PPM) is a small electronic device that is inserted under the skin in the upper chest/shoulder area with connecting wires passed through a vein to the heart. The pacemaker senses if the heart rhythm is abnormally slow allowing stimulation of heart activity when required.
    a. Dependent
    b. Non Dependent
2) Implanted Cardiac Defibrillators (ICD) is a small electronic device that is inserted under the skin in the upper chest/shoulder area with special wires passed through a vein into the heart chambers. It senses dangerously abnormal heart rhythms and delivers pacing or a small shock to restore normal heart rhythm when required.

1) Potential Malfunctions Device Interference occurs when the device senses radiation as cardiac activity. This can lead to shocks or pauses in pacing therapy during the procedure.
2) Device Operational Errors occurs when neutron exposure causes electrical reset, errors in functionality and errors in or loss of diagnostic data.
    a. NOTE: Use photon beam energies less than 10 MV to avoid neutron production
3) Permanent Device Damage can result from exposure to high doses of direct or scattered radiation that may damage the device circuit (may not be immediately apparent)

Purpose:

- To provide safe, quality care during a course of radiation for patients with implanted cardiac devices.
- To provide guidelines for radiation oncology staff when assessing and evaluating patients with implanted cardiac devices prior to and during a course of radiation treatment.
- To provide guidance for the care of a patient receiving radiation therapy treatments.

Critical Elements:

- Identification of patients with CPs and ICDs
- Information about device (location, manufacturer, model #, rate setting if CP)
- Cardiac status of patient (i.e. is the patient pacemaker dependent?)
- Device location relative to treatment field (direct irradiation of CPs and ICDs should be avoided)
- Baseline evaluation of device functionality
- Communication to radiation oncology staff (RTT, Nursing)
- Dosimetry measurements required
- Communication with cardiologist at the discretion of the radiation oncologist
- Definition of 'monitoring' defined per patient (VS pre/post, EKG)
- Frequency of device interrogation (@ EP lab or remotely via phone)
- Follow up cardiac evaluation post treatment as recommended by the radiation oncologist

Procedure:

At the time of initial patient consultation, the physician will ask if the patient has an implanted cardiac device. If yes, the physician will determine device location relative to treatment field and will communicate with the cardiologist at his/her discretion to:

- Determine the cardiac status of the patient (pacemaker dependent)
- Obtain specific information about device (manufacturer, model #, rate setting if CP) which will be scanned into the LMR
- Establish the frequency of device interrogation (@ EP lab or remotely via phone)
- Obtain recommendations for 'monitoring' patient (VS pre/post, EKG)
- Document critical information in LMR H&P and MOSAIQ

Information about the implanted device and device action plan will be communicated to staff (RN, and RTTs) documented in the LMR note called "Cardiac Device Summary". Baseline evaluation of device functionality should be considered prior to treatment start.

At the time of CT/Acuity Simulation, the RT (T) will review the H&P note in LMR for an implanted cardiac device. The RT (T) will ask the patient if he/she has an implanted cardiac device. If the patient answers YES, the RT (T) will notify the physician if knowledge of it is not clearly documented already.

A "Pacemaker Special Consult" document will be created for every patient and will indicate the physician's instructions for physics measurements. A TLD measurement is recommended for all cardiac device patients.

Please NOTE special requests:
ENERGY RESTRICTION: Use photon beam energies less than 10 MV to avoid neutron production.
Please **CONTOUR** the device on the CT planning scan.

Pre treatment QA procedure for check Kelly Seybolt to add

The patient will be scheduled for follow up cardiac evaluation post treatment unless decided otherwise by the radiation oncology physician.

An Algorithm for Guidance (Dutch Society of Radiotherapy on Oncology):

- Low Risk (<2 Gy and NON-dependent) – No extra measures needed.
- Medium Risk (> 2 Gy < 10 Gy and /or dependent)
  University of Michigan recommendation for defibrillator (< 1 Gy)
  - Emergency equipment present during each treatment
  - Weekly CIED check by pacemaker technician
  - Personnel trained in resuscitation and CIED tech or Cardiologist available
- High Risk (> 10 Gy and CIED relocation not possible)
  Does the benefit of RT outweigh the CIED related risks? If yes,
  Emergency equipment present during each treatment
  Weekly CIED check by pacemaker technician
  Personnel trained in resuscitation and CIED tech or Cardiologist available

10/20/.2011

References:
Bush, N.J. Monitoring patients with implanted cardiac rhythm devices. *Oncology* Nursing *Forum*, 2009: 36(6) 629- 632.

Frizzell, B. Radiation therapy in oncology patients who have a pacemaker or implantable cardioverter-defibrillator. *Community Oncology,* 2009: 6(10) 469-471

Solan, A., Solan, M., Bednarz, G & Goodkin, M. Treatment of patients with cardiac pacemakers and implantable cardioverter-defibrillators during radiotherapy. *Int J. Radiation Oncology Biol. Phys*., 2004: 59(3) 897-904.

Sweesy, M., Holland, J., Smith, K. Electromagnetic interference in cardiac rhythm management devices. *AACN Clinical Issues*, 2004: 15(3), 391-403

Metronics Standard Letter Regarding Therapeutic Radiation

University of Michigan, Joann I Prisciandaro, Ph. D. An Institutional Experience Managing the Care of Patients with CIEDs at the AAPM Meeting Spring Clinical Meeting 2014

Dutch Society of Radiotherapy and Oncology (2012) Hurkmans et al., Radiation Oncology, 7,198-215

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