Implanted Cardiac Devices & Radiation

ANNA CURAC – CLINICAL CARDIAC PHYSIOLOGIST
Pacemakers

Implanted For:
- Heart Block
- Symptomatic Bradycardia
- Sick Sinus Syndrome
- Heart Failure
- Medication for arrhythmia treatment that causes their hearts to go too slow
ICDs
Implanted in SCD survivors

And Arrhythmias caused by:
- Ischemia
- Congenital abnormalities
- Structural abnormalities e.g. Cardiomyopathy, Electrical abnormalities e.g. Long QT syndrome
- Heart Failure
“Instead of jogging, can you just set my pacemaker to beat faster for 30 minutes a day while I watch TV?”
# RADIATION THERAPY

## Potential Device Behaviours (temporary or permanent) Due to Radiation Exposure

<table>
<thead>
<tr>
<th>ICDs/ CRT-Ds</th>
<th>Pacemakers/ CRT-Ps</th>
<th>Potential Device Behaviours (temporary or permanent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Altered device status (e.g., premature elective replacement indicator)</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Altered pacing outputs (e.g., decreased pacing amplitude)</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Inhibition of pacing—pacing therapy not provided when needed</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Altered tachyarrhythmia outputs (e.g., shock energy)</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Inhibition of tachyarrhythmia therapy—shock therapy not provided when needed</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Inappropriate shocks—shock therapy provided when not needed</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Complete loss of device function</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Reversion to a safety mode*</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Loss of remote monitoring</td>
</tr>
</tbody>
</table>
University of Michigan Study

- Device patients treated with RT between 2005 and 2011
- 69 patients with devices (19 ICDs and 50 PMs)
- Variety of treatment sites, including 21 patients treated to multiple sites

A summary of the treatment techniques and plans for the 69 patient cohort. The number of plans listed per technique includes the initial treatment plan, replans, and boosts.

<table>
<thead>
<tr>
<th>Treatment Technique</th>
<th>Number of Treatment Plans</th>
<th>Dose/Fraction Range (Gy/fx)</th>
<th>Total Dose Range (Gy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron(s)</td>
<td>16</td>
<td>2–4</td>
<td>4–50</td>
</tr>
<tr>
<td>3D Conformal</td>
<td>53</td>
<td>1.5–8</td>
<td>4–68.4</td>
</tr>
<tr>
<td>3D Conformal with wedge(s)</td>
<td>53</td>
<td>1.5–8</td>
<td>4–64.8</td>
</tr>
<tr>
<td>IMRT</td>
<td>17</td>
<td>1.8–2.5</td>
<td>26–77.7</td>
</tr>
<tr>
<td>SRS</td>
<td>2</td>
<td>16–21</td>
<td>16–21</td>
</tr>
<tr>
<td>SBRT</td>
<td>9</td>
<td>8–18</td>
<td>40–54</td>
</tr>
</tbody>
</table>
Michigan Study Results:

- 2 ICD patients experienced a partial reset of their device
- These patients completed their course of RT
Recommendations for Device patients receiving RT:

1) The cardiac device should not be irradiated with primary radiation;
2) The dose to the device should be estimated prior to RT; and
3) If the cumulative dose to the device is expected to exceed 2 Gy, the device should be interrogated prior to RT and weekly during treatment.
What we do:

- Collaboration between Radiotherapy & Cardiology Teams
- Treatment site & patient’s dependence on device important
- Disable therapy for ICDs & monitor via programmer
- Check post treatment/weekly/monthly
CT & Devices

- Better resolution than Echocardiography or nuclear studies without the contraindication to metal as with MRI
- Metal artifacts can potentially lead to inaccurate assessment
- CT irradiation may cause transient oversensing by implantable devices
- Oversensing in ICDS can cause inappropriate therapy
- Oversensing is transient and the probability of an ICD shock is extremely low
MRI

- Previously contraindicated in device patients

Thought it may:
- Damage device components
- Inhibit pacemaker function
- Trigger rapid pacing
- Deliver inappropriate shocks

Research has proven MRI scans to be safe for device patients who have the appropriate hardware
Conclusions:

- Device patients can safely have RT & MRI scans
- Collaboration between the Therapy & Imaging Teams and Cardiology necessary
Thank You For Listening

"Yes! That was very loud Sir, but I said I wanted to hear your heart!"
References:


4. https://professional-intl.sjm.com/.../media/.../med.../fl-therapeutic-radiation...


9. http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Implantable-Cardioverter-Defibrillator-ICD_UCM_448478_Article.jsp