Radiotherapy Position Statement

The following best practice position statement is a consensus document from CSANZ Heart Rhythm New Zealand (HRNZ).

1. INTRODUCTION

Radiotherapy may adversely affect pacemaker and ICD function due to the effect of ionizing radiation or electromagnetic interference (1,2).

Irradiation:

a) Pacemakers

Irradiation causes ionization of semiconductor materials resulting in excess electron-hole pairs in both the silicon and the silicon dioxide insulator and thence accumulation of positive charge in the oxide. Two main types of pacemaker malfunction may be induced:

- Minor malfunctions posing minimal patient risk such as increases in pulse width, small changes in pacing rate and programmed features and telemetry function defects. Such changes have been detected as low as 2 Gy(3)
- Major malfunctions posing significant patient risk such as extreme fixed rate output, prolonged pacemaker inhibition or total shutdown.

b) Implantable cardioverter defibrillators

Effects of irradiation are not well documented. The Guidant recommendations state CD's to be 5-10 times more sensitive to radiation damage than pacemakers because their operation instructions are stored in random access memory that can be damaged by scatter radiation (4). However a study of 12 ICD's and 8 CRT-ICD's concluded device reset or malfunction from scatter radiation "likely represents an unpredictable, rare occurrence" (5). Direct radiation exposure with cumulative doses >0.5Gy has been stated to potentially cause complete ICD failure (6).

Electromagnetic interference effects are very variable. Pacemaker malfunction is usually temporary, occurring only while the machine is switched on or off and includes temporary output inhibition, temporary fixed rate function, permanent disruption of function and inappropriate reprogramming. Inappropriate shocks due to ICD over-sensing are possible and may be avoided by placing a magnet over the device to temporarily suspend VT and VF therapies until the radiation equipment is turned off.

2. RECOMMENDATIONS

a) Prior to commencement of treatment

- Contact the pacemaker/lCD clinic to ascertain the type of device implanted and to advise the course of treatment planned.
- If radiotherapy is to occur within 15cm of device an individual management plan is to be agreed with the cardiologist. Some devices may need to be re-sited.
- Pacemaker dependency should be assessed and documented. Pacemaker dependent patients should be advised of the small risk of sudden failure.
- Normal pacemaker or ICD function should be documented.

b) During Treatment

- Direct radiation of pacemakers and ICD's should be avoided.
- The device should be shielded, although this will not protect from scatter radiation.

- ECG and pulse oximeter monitoring is necessary for pacemaker dependent patients or those with an ICD.
- The radiation beam should miss the device by 2.5cm.
- Total accumulated dose to the device should be < 2gy for a pacemaker and < 1gy for an ICD.
- ICD patients should have their device deactivated for the first session while the patient is monitored for electromagnetic interference.

c) Follow-up checks during the course of:

treatment Pacemakers

- Weekly checks for the duration of treatment.
- Final check at the completion of treatment and a month later to look for late threshold rises or circuit damage.
- Any evidence of pacemaker malfunction lasting more than a few seconds should be regarded as an indication to consider changing the generator.

ICD's

- Daily ICD checks for the first week of treatment.
- Weekly checks for the duration of treatment.
- Final check at the end of treatment and a month later to look for late threshold rises or circuit damage.

References

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