Radiation safety following the death of a patient implanted with sealed radioactive sources and the role of the RSO

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OUTLINE

• Available resources
• Brachytherapy
  – What is brachytherapy
  – What technique we are using
• Brachytherapy and Radiation Safety
• Relevant Regulations and RSO
• Deceased patients and Radiation Safety
  – Funeral Home
  – Morgue
Available Resources

• **NCRP Report No. 37**
  – Precautions in the management of patients who have received therapeutic amounts of radionuclides. Oct, 1970

• **NCRP Report No. 155**
  – Management of Radionuclide Therapy patients, Jan 2006

• **ICRP 98**
  – Radiation Safety of brachytherapy for prostate cancer using permanently implanted seeds, 2005
Available Resources

• NCRP 37 and NCRP 155
  – Provided detailed guideline to handle deceased patients (embalming, cremation) who died after receiving radionuclide treatments
  – The reports covered various types of therapeutic procedures

• ICRP 98
  – Specifically discussed about the permanent implants of I125 and Pd103 for prostate brachytherapy.
Brachytherapy

- Brachytherapy is defined as;
  - Targeted cancer treatment where a radiation source is placed a short distance from or in the tumor
Brachytherapy

- Brachytherapy
- LDR – Low dose rate brachytherapy
- Manual brachytherapy
- HDR – High dose rate brachytherapy
- PDR – Pulse dose rate brachytherapy
Brachytherapy

• Low/intermediate risk patients are chosen as candidate for permanent seed implantation - brachytherapy
  – Survival rate is high
    • ~100% in 5 years
    • Recurrence rate is ~5% in 5 years

• It is not anticipated that patient will die from the complications from the treatment
  – Patient died after brachytherapy
    • Heart attack
    • Car accident
    • Other complication
Brachytherapy – at TBCC

• Prostate brachytherapy
  – We treat approximately 94 patients every year
  – Last five years we have treated approximately 470 patients

• Breast brachytherapy
  – We started Nov 2013
    • Treated 31 patients until now
Brachytherapy – at TBCC

Typical dimension and composition of I-125 seed

Typical dimension and composition of Pd-103 seed

The seeds remain in the patient for the rest of their lives. Titanium is used as it is very bio-compatible.
Prostate brachytherapy – at TBCC

Prostate gland

Treated with I125 seeds
Breast brachy – at TBCC

- Tumor in the breast (surgical cavity)
- Tumor treated with Pd-103 seed the breast
Brachytherapy – at TBCC

Patient released with wallet card

**Prostate brachy**
- Patient Name: [Blank]
- Received a permanent radioactive implant of the prostate containing I-125 seeds on [Date]
- (Please dispose of card 20 months after above date)
- (Medical Physicist)
- Tom Baker Cancer Centre

**Breast brachy**
- Patient Name: [Blank]
- Received a permanent radioactive implant of the prostate containing I-125 seeds on [Date]
- (Please dispose of card 6 months after above date)
- (Medical Physicist)
- Tom Baker Cancer Centre

**Other side of the card:**
- For Radiation Safety issues
  - Mon – Fri (9am – 5 pm) (403) 521-3798
  - For emergencies, or after hours contact (403) 944-1110
- Request to speak with the on-call oncologist
Brachytherapy – Radiation Safety

• Radioprotection for family members

  – NCRP recommends that the partner’s effective dose should be less than 5 mSv/yr

<table>
<thead>
<tr>
<th>Prostate brachytherapy</th>
<th>Breast brachytherapy</th>
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<tbody>
<tr>
<td>May be less doserate because the depth in tissue at which the seeds are placed</td>
<td>Seeds may have a relatively small amount of tissue covering the implant</td>
</tr>
<tr>
<td>Always centrally located</td>
<td>Depending on the seroma location a larger amount of tissue may cover the implant if radiation exposure is measured in the other direction</td>
</tr>
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# Brachytherapy – Radiation Safety

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<tr>
<td>Seeds</td>
<td>I-125</td>
<td>Pd-103</td>
</tr>
<tr>
<td>Delivery method</td>
<td>Seeds in cartridge</td>
<td>Preloaded needles</td>
</tr>
<tr>
<td>Photon energy</td>
<td>35 keV</td>
<td>21 keV</td>
</tr>
<tr>
<td>Activity of each seed</td>
<td>~ 0.5 mCi</td>
<td>~ 1.93 mCi</td>
</tr>
<tr>
<td>Half life</td>
<td>59 d</td>
<td>17 d</td>
</tr>
<tr>
<td>Patient treated with</td>
<td>60-100 seeds</td>
<td>20 – 100 seeds</td>
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# Brachytherapy – Radiation Safety

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<tr>
<td>Shielding</td>
<td>Thin metal foil</td>
<td>Thin metal foil</td>
</tr>
<tr>
<td>Critical Organ</td>
<td>Thyroid gland</td>
<td>N/A</td>
</tr>
<tr>
<td>Suggested protection if handled ruptured or damaged seeds</td>
<td>Thyroid scan within 72 hours of handling 1 mCi or more or after any suspected intake</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Brachytherapy – Deceased Patient

• Cremation is concern
  – The activity remains in patient ashes
  – Irradiation of crematorium staff and family members

• Airborne dose
  – Inhalation of radioactive particles by cremation staffs, member of the public is also concern
Brachytherapy – Decease Patient

• Cremation is recommended (ICRP 98)
  – I-125 seeds if 12 months elapsed after the date of
  – Pd-103 seeds if 3 months elapsed after the date of implant

Prior to 12 (3) months it is recommended to remove the organ from the dead body and store the organ (seeds)

• If removing organ is not possible cremation is recommended with special precaution
Brachytherapy – Decease Patient

• According to one publication*

  – if the patient died immediately after the implant the residual activity in the cremated remains are in the range 600-6000 µCi

  – Inhaling 4 µCi or ingestion of 2 µCi of I-125 will translate the radiation dose of 1 mSv

Hence should take a precaution if cremation is needed before the end of 20 months of the date of implantation even though it is recommended after 12 months of implantation

Relevant Regulations - RSO

• No federal and provincial guidelines
  – Once the seeds inserted in the patient and the patient leaves the hospital
  – In the event when patient died with the seeds (radioactive material) within the body.

• RSO receive call requesting guidance
  – Not sure where and how to reach for information
  – How to guide the patient’s family, radiation therapy department, funeral home, morgue
Relevant Regulations - RSO

• As a RSO at TBCC dealt with three cases in the last five and half years
  – One of the patient died after 75 days of the treatment and the other two ~ 9 months after the implant
Brachytherapy – Decease Patient

Instruction for Funeral home

• Embalming is ok – the staff will not be exposed to any unnecessary exposure when dealing with such deceased as the sources are sealed.

• If cremating (before 20 months)
  – Wear a respirator with appropriate filter when handling cremated remains
  – Use of rubber/vinyl gloves during handling and washing hands afterwards is recommended
  – Gloves and filter can be surveyed by the radiation safety expert before disposal
Brachytherapy – Radiation safety

- Instruction for Funeral home

  • The cremated remains should not be processed and should put in a metal urn for storage or burial
  • The cremated remains can hand over to the family with the instruction not to scatter in the environment until a minimum of 20 months for I125 and for 6 months for Pd103
Brachytherapy – Radiation safety

Instruction for Morgue at the Hospital

- If morgue is removing the prostate of the patient
- They need the radiation safety support
  - Provide the staff with ring dosimeter
  - The metal container to store the organ
  - The radiation symbol and the date until when to dispose the organ
  - Dispose as regular biohazard waste
  - Follow up when it is time to dispose
Acknowledgement

- Eduardo Villarreal Barajas, PhD, Senior Medical Physicist, TBCC.
Safety Begins with You
Question