Advances in permanent source implantation for LDR brachytherapy of various anatomical sites

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2nd Talk: Learning Objectives

1. Understand the evolution of PSI radionuclides and grasp their dosimetric differences.

2. Learn various techniques used for PSI in different anatomical sites.
Evolution of PSI Radionuclides

• sources initially developed using radiochemical separation: $^{226}$Ra and $^{222}$Rn

• later with nuclear activation (atomic age) and radiochemistry:
  $^{191}$Ir(n,γ)$^{192}$Ir, $^{197}$Au(n,γ)$^{198}$Au
  $^{124}$Xe(n,γ)$^{125}$Xe==>$^{125}$I, $^{103}$Rh(p,n)$^{103}$Pd, $^{130}$Ba(n,γ)$^{131}$Ba==>$^{131}$Cs
  electron capture
  radiochemistry

• development trend has been for:
  a) low energy: safe for personnel and public, easily shieldable
  b) shorter half-life: increased BED, combination with EBRT
  c) capsule standardization: equipment compatibility

PSI General Dosimetry

• low-E PSI sources exhibit higher dose falloff and larger dose gradients than $^{192}$Ir

• low-E PSI dosimetry is more sensitive to positioning variations (initially and during decay)

• these factors influence various anatomic sites differently

PSI for Lung Cancer

• stranded $^{125}\text{I}$ seeds sutured to lobectomy surgical margin
• required high surgical skill
• subject to high/low dose regions


PSI for Lung Cancer

• $^{125}\text{I}$ seeds in vicryl mesh sutured to lobectomy surgical margin
• requires less surgical skill
• less subject to high/low dose regions

PSI for Breast Cancer

• CT-based pre-implant treatment plan performed for PSI (\(^{103}\)Pd) ordering 2 weeks prior to OR

• seroma cavity with PTV margin is delineated under US, needle entry paths determined to guide subsequent surgery

• OR setup concerns for arm position, muscle tension, template position, and fiducial needle position located via US

• post-implant CT dosimetry performed same day as implant

PSI for Breast Cancer


PSI for Brain Cancer

• historically implanted few $^{125}$I seeds during tumor resection
• many single institutional studies, promising alternative to WBRT
• Wernicke and colleagues researched $^{131}$Cs in the past decade
• stranded seeds and devices are now being used

Schwarz et al. Rad Oncol 7: 30 (2012).
TABLE III. Summary of dose conversion for fast growing tumors. D(Au, I, Pd) is the reference dose for a given isotope (Au-198, I-125, Pd-103), and D(Cs-Au, I, Pd) is the Cs-131 dose converted from the corresponding isotope dose.

<table>
<thead>
<tr>
<th>D(Au, I, Pd) (Gy)</th>
<th>10</th>
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<th>30</th>
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<th>50</th>
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<tr>
<td>D(Cs-Au) (Gy)</td>
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<td>D(Cs-I) (Gy)</td>
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<tr>
<td>D(Cs-Pd) (Gy)</td>
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<td>169</td>
<td>187</td>
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TABLE IV. Summary of dose conversion for slow growing tumors. D(Au, I, Pd) is the reference dose for a given isotope (Au-198, I-125, Pd-103), and D(Cs-Au, I, Pd) is the Cs-131 dose converted from the corresponding isotope dose.

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<td>D(Cs-I) (Gy)</td>
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<td>D(Cs-Pd) (Gy)</td>
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PSI for Head & Neck Cancer


PSI for Head & Neck Cancer

Conclusions

- PSI has been used successfully for many years for a variety of anatomic sites
- surgical techniques are more streamlined, using CT/MRI/US for pre-implant planning
- newer radionuclides and source assemblies can improve dose distributions

Related Reading: Lung

**Related Reading: Breast**


**Related Reading: Brain**

Related Reading: Head & Neck