ARRO Case:
HDR Prostate Brachytherapy

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Case Presentation

- 67 year old male presented with an elevated PSA at 3.55 ng/mL
- Found to have no evidence of abnormalities on DRE
- Underwent prostate biopsy
Case presentation continued

• Discussed various treatment options including:
  – Active surveillance
  – Radical prostatectomy
  – External beam radiation
  – HDR prostate brachytherapy as a monotherapy
  – Other options include LDR brachytherapy and SBRT
• Patient wanted to proceed with brachytherapy
Brief History of Prostate Brachytherapy

• 1917 – Barringer inserted radium needles transperineally in the prostate
• 1952 – Flocks et al. injected radioactive gold solution into prostate cancer
• 1972 – Willet Whitmore described an open implant technique using $^{125}\text{I}$
• 1983 – H. Holm described technique of implanting the prostate with radioactive seeds
Radiobiology behind prostate brachytherapy

• Prostate tumors have small fraction of cycling cells and possibly a low $\alpha/\beta$ ratio

• A meta-analysis of 20+ studies has estimated the $\alpha/\beta$ ratio between 1-4 Gy with a mean of 2.7 Gy

• Thus, hypofractionation might be more effective for prostate cancer
Patient history

- Urologic history
  - Prior transurethral or open resection of the prostate or other surgery on the urethra
  - Prior procedure for BPH
  - Medication for urinary obstructive symptoms
  - Erectile function
- Prior diagnosis of cancer, especially rectal or bladder cancer
- Prior pelvic radiotherapy, surgery, or fracture
- Inflammatory bowel disease
- Connective tissue disorder
- Documentation of the IPSS
- Documentation of erectile function, International Index of Erectile function score
Work-up

- Prostate biopsy within the last 12 months
- PSA
- DRE
- Prostate volume
- Can tolerate extended dorsal lithotomy position
- Suitability for anesthesia
Indications for prostate brachytherapy

**Patient factors**
- Life expectancy > 5 year
- IPSS < 15
- Prostate volume < 60 cc
- No defect with previous TURP
- Minimal pubic arch interference

**Tumor factors**
- Monotherapy
  - T1-T2b
  - Gleason ≤ 7 (3+4)
  - PSA ≤ 15
- Boost
  - ≥T2c
  - Gleason ≥ 7
  - PSA ≥ 10
Contraindications to prostate brachytherapy

Absolute

• Limited life expectancy
• Unacceptable operative risk
• Distant metastases
• Absence of a rectum or rectal fistula
• Large TURP defect
• Ataxia telangiectasia

Relative

• High IPSS (>20)
• History of prior pelvic RT
• TURP defect
• Large median lobe
• Gland size > 60 cc
• Inflammatory bowel disease
  – Want asymptomatic and have not required medical management for greater than 6 months
Pre-brachytherapy prostate ultrasound

- Goal: To determine if patient is a candidate for prostate brachytherapy
- Determine prostate size and length
- Determine if the patient has any arch interference
- Determine if there is any other reasons patient cannot tolerate brachytherapy
HDR technique

- Patient is placed under spinal or general anesthetic
- Positioned in supine in lithotomy position
- Contrast is placed in the bladder
- Urethra can be identified using Mucogel and/or foley.
  - Issue with foley is potential changes in the prostate anatomy
- Needles are placed in the prostate at regular intervals
- For CT-based planning, images should be contiguous and no more than 3 mm thick in axial plane. Should extend at least 9 mm above and below the target volume
- Patient received 1350 cGy x 2 fractions separated by 2 weeks
- Patients are discharged same day after regaining urinary function
# HDR constraints

<table>
<thead>
<tr>
<th>Organ</th>
<th>Volume</th>
<th>Constraint</th>
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<tbody>
<tr>
<td>CTV</td>
<td>V100</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>CTV</td>
<td>V125</td>
<td>50-60%</td>
</tr>
<tr>
<td>CTV</td>
<td>V150</td>
<td>&lt;35%</td>
</tr>
<tr>
<td>Rectum</td>
<td>D2cc</td>
<td>&lt;70%</td>
</tr>
<tr>
<td>Rectum</td>
<td>V75</td>
<td>&lt;1 cc</td>
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<tr>
<td>Bladder</td>
<td>V75</td>
<td>&lt;1 cc</td>
</tr>
<tr>
<td>Urethra</td>
<td>V115</td>
<td>&lt;1 cc</td>
</tr>
</tbody>
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Case Presentation - DVH

- **Prostate**
  - $V_{100} = 99.02\%$
  - $V_{125} = 50.04\%$
  - $V_{150} = 17.59\%$
  - $V_{200} = 4.59\%$

- **Urethra**
  - $V_{100} = 91.48\%$
  - $V_{110} = 9.45\%$

- **Rectum**
  - $V_{75} = 0\%$
Case Presentation – Isodose (axial)
Case Presentation – Isodose (sagittal)
Case Presentation – X-Ray

- Pre-treatment x-ray showing needles in the prostate in the same position
References

