Brachytherapy in Early Stage Prostate Cancer

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Learning Objectives

- To select patients with early stage prostate cancer for brachytherapy
- To learn the skill of interstitial brachytherapy
- **Ultimate aim:** To motivate you for prostate brachytherapy
Early Stage Prostate Cancer

• Organ confined disease
• Carries excellent prognosis
• Multiple options
  - Watchful waiting or Active surveillance
  - Radical Prostatectomy
  - Radiation Therapy: EBRT or Brachytherapy
Brachytherapy for Carcinoma Prostate

• As monotherapy: for low risk patients

• As Boost: for intermediate and high risk pts

• As salvage therapy: for recurrent cases
Why Brachytherapy?

- Conformal treatment
- Very high dose (~150 Gy)
- Short course therapy
- Excellent local control
- Better quality of life
- Preservation of sexual function
- Cost effective
Brachy the most conformal technique for dose escalation

Brachytherapy the best for prostate...
Prostate Brachytherapy is simple

- Anatomically accessible
- TRUS guidance
- Small tissue
- Silent malignancy
Types of Brachytherapy

- High dose Rate (HDR) Brachytherapy
- Low dose Rate (LDR) Brachytherapy or Seed Brachytherapy
HDR Brachytherapy: Indications

Monotherapy
- Low and intermediate risk (select)

Boost (combined with EBRT)
- any T with N0 M0
- any PSA
- any Gleason-Score
American Brachytherapy Society consensus guidelines for high-dose-rate prostate brachytherapy

Yoshiya Yamada¹,* , Leland Rogers², D. Jeffrey Demanes³, Gerard Morton⁴, Bradley R. Prestidge⁵, Jean Poulion⁶, Gil’ad N. Cohen⁷, Marco Zaider⁷, Mihai Ghilezan⁸, I-Chow Hsu⁶

Task Group/Practice Parameter

American Brachytherapy Society Task Group Report: Combination of brachytherapy and external beam radiation for high-risk prostate cancer

Daniel E. Spratt¹, Payal D. Soni¹, Patrick W. McLaughlin¹,* , Gregory S. Merrick²,³, Richard G. Stock⁴, John C. Blasko⁵, Michael J. Zelefsky⁶
HDR Brachytherapy: contraindications

**Absolute**
1. Preexisting rectal fistula,
2. Medically unsuited for anesthesia, and
3. No proof of malignancy.

**Relative**
High pubic arch, Median lobe hypertrophy, or any other technical/dosimetric contra-indication (e.g. improper lithotomy)
Patient Preparation

Spinal anesthesia

Lithotomy position

Foley catheter (Tri-lumen)
Procedure

USG with TRUS probe
Let the Foley's be high up to avoid balloon rupture
LP Needle to Decide the Position of Template

Template fixation
TRUS Imaging

Fixation of probe and template on the stepper
Needle insertion using USG guidance
Dose Colour wash

3D Reconstruction

DVH

Treatment
Phantom Trials to Streamline Workflow Logistics
Continuous TRUS-image-recording with online transfer to the real-time planning system
Definition of base plane, reference plane and apex
Prostate Steps contd..

- Needle insertion as per preplan
- Repeat 3D USG
- Catheter reconstruction and contouring
- Final plan and evaluation
- Connect for treatment
- Implant removal
- Bladder irrigation for hemostasis
Dosimetry
Pre-implant & Post Implant Care

- Antibiotic on the morning of implant
- Complete bowel preparation with PEGLEC the day prior
- Part preparation
- Post procedure Anti inflammatory, antibiotics & alpha blockers
- Bladder irrigation with normal saline till hematuria subsides
- Foleys out the next day
<table>
<thead>
<tr>
<th>Institution</th>
<th>Dose fractionation</th>
<th>Bladder</th>
<th>Urethra</th>
<th>Rectum</th>
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<tbody>
<tr>
<td>MSKCC</td>
<td>Boost 7Gyx3</td>
<td></td>
<td>&lt;120% prescription</td>
<td>$D_{2\text{ cc}} &lt; 70%$</td>
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<tr>
<td></td>
<td>Mono 9.5Gyx4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Salvage 8Gyx4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UCSF</td>
<td>Boost 15Gyx1</td>
<td>$V_{75} &lt; 1 \text{ cc}$</td>
<td>$V_{125} &lt; 1 \text{ cc}$, $V_{150} = 0 \text{ cc}$</td>
<td>$V_{75} &lt; 1 \text{ cc}$</td>
</tr>
<tr>
<td></td>
<td>Mono 10.5Gyx3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salvage 8Gyx4*</td>
<td></td>
<td>*(dose tunnel whenever possible)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(intra-op TRUS-based dosi)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>WBH</td>
<td>Boost 10.5Gyx2</td>
<td>No constraint</td>
<td>$V_{100} &lt; 90%$ of prescription</td>
<td>$V_{75} &lt; 1%$ of prescription</td>
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<tr>
<td></td>
<td>Mono 4 x 9.5 Gy (historical)</td>
<td></td>
<td>$V_{115} &lt; 1%$ of prescription</td>
<td></td>
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<tr>
<td></td>
<td>12–13.5Gyx2 (current)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salvage 7Gyx4 combined with hyperthermia</td>
<td></td>
<td></td>
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<tr>
<td>TCC</td>
<td>Boost 6Gyx2 ×2 implants</td>
<td>&lt;80% of Rx</td>
<td>&lt;125% of prescription</td>
<td>&lt;80% of Rx to outer wall</td>
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<tr>
<td>GW</td>
<td>Boost 6.5Gyx3</td>
<td>&lt;100% prescription</td>
<td>&lt;110% prescription</td>
<td>mucosa &lt;60%, outer wall &lt;100%</td>
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<tr>
<td></td>
<td>Mono two sessions of 6.5Gyx3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Toronto</td>
<td>Boost 15Gyx1</td>
<td>n/a</td>
<td>$D_{10} &lt; 118%$</td>
<td>$V_{80} &lt; 0.5 \text{ cc}$</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Max &lt; 125%</td>
<td></td>
</tr>
<tr>
<td>UCLA-CET</td>
<td>Boost 6Gyx4</td>
<td>90–100% wall</td>
<td>120% combo</td>
<td>Rectal wall 80%</td>
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<tr>
<td></td>
<td>Mono 7.25Gyx6</td>
<td>80% balloon</td>
<td>105% any TUR</td>
<td>Rectal wall 80–85%</td>
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Seed Brachytherapy in Carcinoma Prostate
Permanent prostate implant

- Mainly monotherapy
- May be used as boost
- Salvage of recurrent tumors
Patient selection

I-125/Pb-103 Mono-therapy:

- cT1 ~ T2b
- PSA < 10
- GS: 2 - 6
- T1-T2 / GS < 7 / PSA < 10,
American Brachytherapy Society consensus guidelines for transrectal ultrasound-guided permanent prostate brachytherapy

Brian J. Davis¹,*, Eric M. Horwitz², W. Robert Lee³, Juanita M. Crook⁴, Richard G. Stock⁵, Gregory S. Merrick⁶, Wayne M. Butler⁶, Peter D. Grimm⁷, Nelson N. Stone⁸, Louis Potters⁹, Anthony L. Zietman¹⁰, Michael J. Zelefsky¹¹
<table>
<thead>
<tr>
<th>Risk group per NCCN</th>
<th>Brachytherapy alone?</th>
<th>Combined with EBRT?</th>
<th>Combined with androgen deprivation?</th>
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<tbody>
<tr>
<td>Low</td>
<td>Yes</td>
<td>Not favored</td>
<td>Not favored</td>
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<tr>
<td>Intermediate</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
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<tr>
<td>High</td>
<td>No</td>
<td>Yes</td>
<td>Favored</td>
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</table>
Absolute contraindications to TRUS-guided PPB

Limited life expectancy
Unacceptable operative risks
Distant metastases
Absence of rectum such that TRUS guidance is precluded
Large TURP defects, which preclude seed placement and acceptable radiation dosimetry
Ataxia telangiectasia
<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Half-life (d)</th>
<th>Average energy (keV)</th>
<th>Year introduced</th>
<th>Typical monotherapy seed strength (mCi)</th>
<th>(U)</th>
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<tbody>
<tr>
<td>$^{125}$I</td>
<td>59.4</td>
<td>28.4</td>
<td>1965</td>
<td>0.3–0.6</td>
<td>0.4–0.8</td>
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<tr>
<td>$^{103}$Pd</td>
<td>17.0</td>
<td>20.7</td>
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<td>1.1–2.2</td>
<td>1.4–2.8</td>
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<tr>
<td>$^{131}$Cs</td>
<td>9.7</td>
<td>30.4</td>
<td>2004</td>
<td>2.5–3.9</td>
<td>1.6–2.5</td>
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<tr>
<td>Radioisotope</td>
<td>Monotherapy</td>
<td>Combination</td>
<td></td>
<td></td>
<td></td>
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<td>-------------</td>
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<tr>
<td>(^{125}\text{I})</td>
<td>140–160 Gy</td>
<td>41.4–50.4 Gy (1.8 Gy/d(^{a}))</td>
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<tr>
<td>Combination</td>
<td>PPB dose</td>
<td>108–110 Gy</td>
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<tr>
<td>EBRT</td>
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<tr>
<td>(^{103}\text{Pd})</td>
<td>110–125 Gy</td>
<td>41.4–50.4 Gy (1.8 Gy/d(^{a}))</td>
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<tr>
<td>Combination</td>
<td>PPB dose</td>
<td>90–100 Gy</td>
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<tr>
<td>EBRT</td>
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</table>
Implant procedure
**STEPS:**

**Planning** - TRUS guided volume study—computer preplan

**Brachytherapy procedure** - TRUS guided trans perineal needle—.. peripheral loading..

seeds placed along the tract from base to apex.

**Post implant evaluation** - by CT scan
Aim to keep $UV_5 < 150\%$ and $UV_{30} < 125\%$ in the preplan.
I\(^{125}\)/ Pd\(^{103}\) Monotherapy
PSA Progression-Free Survival
n = 403

Cumulative Survival

@risk

0-4 ng/ml
4-10 ng/ml
10-20 ng/ml
>20 ng/ml

0 12 24 36 48 60 72 84 96 108 120
Time post-implant (months)
I\textsuperscript{125}/ Pd\textsuperscript{103} Monotherapy

PSA Progression-Free Survival

n = 403

Cumulative Survival

Time post-implant (months)

@risk

GS 2-4
n = 158

GS 5-6
n = 197

GS >=7
n = 40
I^{125} / Pd^{103} Implant ± EBRT

PFS: “Unfavorable Risk Group”*

cT3 or GS >6 or iPSA >10: (2+ factors)

Cumulative Survival

Time post-implant (months)

54% 62% + EBRT

Monotherapy

n=52

n=13

p=0.53

Acute Symptoms

- Dysuria (often)
- Hematuria (common)
- Perineal hematoma (significant < 3 %)
- Obstruction (5-12%)
- Perineal Pain (< 5%)
- Diarrhea (< 10%)
Delayed Complications

• Chronic cystitis (3-7 %)
• Incontinence (1% for non-TURP, 25-42% for TURP)
• Rectal ulceration (< 1 %)
• Urethral necrosis (< 1 %)
• Erectile dysfunction (> 70y/o, 20-25%; < 70y/o, 10-15%)
Conclusion

• Brachytherapy can be used as
  - monotherapy for low risk patients
  - boost for intermediate/high risk patients
• Provides excellent local control
• Preservation of sexual function
• Cost effective treatment
• Indian centers should adopt the practice of prostate brachytherapy
THANK YOU