TRANS RECTAL ULTRASOUND GUIDED HIGH DOSE RATE INTERSTITIAL BRACHYTHERAPY FOR CARCINOMA PROSTATE

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CARCINOMA PROSTATE

- Uncommon malignancy
- Implantable cases are rare
  - 22 / 1000 LDR 10 years
  - 21 / 500 HDR 5 years
- Inappropriate training
- TRUS & brachytherapy under one roof
- Dedicated systems are expensive
BRACHYTHERAPY

- Accessibility -- good
- Imaging -- amenable
- Invasiveness -- minimal
- Radiation tolerance -- good
- Dose escalation -- beneficial
- Dispensability -- high
- Critical organs -- close by
INDICATIONS

• Stage T1b to T3b
• Any Gleason score
• Any PSA level
• M0

• Low risk -- monotherapy
• Intermediate / high risk – as boost
CONTRAINDICATIONS

ABSOLUTE

- M1 disease
- Medically unfit for anesthesia
- Life expectancy < 5 years
- Technically not feasible to implant whole gland

RELATIVE

- Gland > 80 cc → Pubic arch interference
- TURP last six months or large TURP defect
- Obstructive urinary symptoms IPSS > 14
- Prior pelvic radiotherapy
TURP

- Mostly unnecessary
- If IPSS >20 (shows obstruction)
- Complications
- Poor survival
- Delays RT by 3-6 months.
- Excessive urinary morbidity.
BRACHYTHERAPY - TYPES

- Permanent seed implants
- Manually afterloaded low dose rate (LDR)
- Remote afterloaded high dose rate (HDR)
SPECIAL CONSIDERATIONS

- Pre op. low residue diet
- Pre op. laxatives / enema
- Liquid diet intra op.
- Flatus tube
- Three way urinary catheter
- Epidural anaesthesia and analgesia
TRUS GUIDED BRACHYTHERAPY

• Allows direct and continuous visualization of the relationship between
  Rectal wall
  Urethra
  Urinary bladder
  Prostate contour

• Precise dose delivery system
• Very effective treatment
Post-Implant Cystoscopy

cystoscope
bladder
prostate
rectum
needles
OPTIMIZATION CONSTRAINTS

- Max. urethral dose $\leq 125\%$ MPD
- MPD allowed to indent few mm. anteriorly but still covered by 80\% isodose
- Higher doses to posterolateral portions (anatomic rationale) 150-200\%
- Rectal dose $\leq 75\%$
HDR EXPERIENCE

- August 2003 – May 2008 – 22 cases
  - 1 -- Low risk
  - 10 -- Intermediate risk
  - 11 – High risk

- T2b – T3b   Gl. 6- 8  PSA .13 – 191
- XRT 50.4 Gy 3DCRT / 54Gy by IMRT
- ISBT minimum peripheral dose (MPD)
  - 5.5Gy x 3   -- 5
  - 5.5 Gy x 4   -- 5
  - 7.5 Gy x 2   -- 7
  - 8.5 Gy X 2   -- 4
  - 8.5 Gy x 4   -- 1

- Follow up 5 – 51 m.    LC – 100%    One dead lung mets.
- No significant morbidity
# MORBIDITY

<table>
<thead>
<tr>
<th></th>
<th>LDR</th>
<th>HDR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACUTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haematuria</td>
<td>22/22</td>
<td>3/22</td>
</tr>
<tr>
<td>Retention</td>
<td>0/22</td>
<td>2/22</td>
</tr>
<tr>
<td>GU gr. III</td>
<td>2/22</td>
<td>0/22</td>
</tr>
<tr>
<td><strong>CHRONIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proctitis</td>
<td>1/22</td>
<td>0/22</td>
</tr>
<tr>
<td>Stricture</td>
<td>0/22</td>
<td>0/22</td>
</tr>
</tbody>
</table>
HIGH DOSE RATE BRACHYTHERAPY

- No organ motion concerns
- Optimization allows IMRT
- High dose / fraction suits radiobiology of prostate cancer
  - Short treatment time
  - Minimum isolation → Better nursing care
  - Minimal hospitalization → Better patient compliance
  - Significantly reduced cost
  - No second malignancy concerns
HIGH DOSE RATE BRACHYTHERAPY

• Infinite optimization possibilities due to more number of channels, dwell positions and dwell times

ALLOWS INTENSITY MODULATION WITHIN AND IMMEDIATELY AROUND PROSTATE

• Better integration of XRT and BT may yield better cure rates
INTENSITY MODULATION USING HDR

- Correction of suboptimal needle placement makes it a forgiving type of procedure
- Possible to treat bigger size prostates with lesser needles by increasing dwell times in lateral or anterior needles
- Boost to areas of known gross disease
- Lesser dose to rectum by decreasing dwell times in posterior needles
Seeds

HDR

Resulting Dose Distributions
INTENSITY MODULATION UNIQUE TO HDR

• Decreased dose to urethra

• Major limitation of IMRT is inability to do this (No significant reduction of urinary morbidity)
Fig. 2. Biochemical control (BC) stratified by risk factor groups.
BRACHYTHERAPY VERSUS 3D-CRT

5 YEAR BRFS (%)

<table>
<thead>
<tr>
<th>Method</th>
<th>FR</th>
<th>IR</th>
<th>HR</th>
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<tbody>
<tr>
<td>3DCRT</td>
<td>90</td>
<td>70</td>
<td>47</td>
</tr>
<tr>
<td>SEEDS</td>
<td>94</td>
<td>82</td>
<td>65</td>
</tr>
<tr>
<td>SEED + XRT</td>
<td>85</td>
<td>77</td>
<td>45</td>
</tr>
<tr>
<td>HDR + XRT</td>
<td>96</td>
<td>87</td>
<td>69</td>
</tr>
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</table>
### Table 1. Equivalent dose per brachytherapy dose level

<table>
<thead>
<tr>
<th>Dose level</th>
<th>Brachytherapy dose</th>
<th>$\alpha/\beta = 10$</th>
<th>$\alpha/\beta = 5$</th>
<th>$\alpha/\beta = 1.2^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low dose</td>
<td>5.50 Gy × 3</td>
<td>67.1</td>
<td>70.7</td>
<td>80.2</td>
</tr>
<tr>
<td></td>
<td>6.00 Gy × 3</td>
<td>70.0</td>
<td>74.3</td>
<td>86.1</td>
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<tr>
<td></td>
<td>6.50 Gy × 3</td>
<td>72.6</td>
<td>78.1</td>
<td>92.5</td>
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<tr>
<td>High dose</td>
<td>8.25 Gy × 2</td>
<td>72.0</td>
<td>78.8</td>
<td>94.2</td>
</tr>
<tr>
<td></td>
<td>8.75 Gy × 2</td>
<td>74.2</td>
<td>82.1</td>
<td>99.9</td>
</tr>
<tr>
<td></td>
<td>9.50 Gy × 2</td>
<td>78.0</td>
<td>87.1</td>
<td>108.9</td>
</tr>
<tr>
<td></td>
<td>10.50 Gy × 2</td>
<td>82.9</td>
<td>94.4</td>
<td>122.0</td>
</tr>
<tr>
<td></td>
<td>11.50 Gy × 2</td>
<td>87.0</td>
<td>99.8</td>
<td>136.3</td>
</tr>
</tbody>
</table>

*Abbreviation: BED = biologically equivalent dose.

* To 2 Gy per fraction, 70 Gy total external beam dose.

$^*$ $\alpha/\beta$ ratio of 1.2 derived from our clinical trial (39).
HDR AS MONOTHRAPY

- Favorable risk patients
- 5 year BRFS 98%
- Longer follow up needed

GRILLS et al, J. Urol., 2004
HDR AS MONOTHERAPY

- 297 patients

- 8.5Gy x 4 in one implant  Eq. 75.6 Gy in 1.8 Gy/ fr
  7 Gy x 6 in two implants  Eq. 76 Gy in 2.0 Gy Gy/ fr

- 5 year results
  OAS – 94.5%  DM – 0%
  CSS – 100%  BRFS – 91% (Phoenix)
  LC – 98.9%  GU toxicity -- < 1%

Martinez et al, Brachytherapy, 7(2), 2008
<table>
<thead>
<tr>
<th>Toxicities</th>
<th>HDR (%)</th>
<th>$^{103}$Pd (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute dysuria (Grades 1–3)</td>
<td>36</td>
<td>67</td>
</tr>
<tr>
<td>Acute urinary frequency/urgency</td>
<td>54</td>
<td>92</td>
</tr>
<tr>
<td>Urethral stricture</td>
<td>32</td>
<td>56</td>
</tr>
<tr>
<td>Chronic urinary frequency/urgency</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Urethral stricture</td>
<td>16</td>
<td>4.5</td>
</tr>
<tr>
<td>Three-year impotency rate</td>
<td></td>
<td></td>
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</tbody>
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Most of above toxicities were Grade 1.
No difference in chronic dysuria, incontinence retention, and hematuria.
BRACHYTHERAPY

- Highly conformal dose to prostate (viz. 7 field 3D-CRT/ IMRT)
- Radiobiologically appropriate
- Better normal tissue sparing
- No set up / organ motion and localization errors
- Convenient
- Quick
ADVANTAGES OF BRACHYTHERAPY OVER IMRT

- Significantly less investment
- Negligible recurring costs
- Cheap therapy
- Even best form of IMRT is still an XRT only.
- Radiobiologically superior
- Clinically and financially more relevant to Indian conditions
IMAGE BASED OPTIMIZED HIGH DOSE RATE CONFORMAL BRACHYTHERAPY IS THE BEST FORM OF IMRT
THANK YOU