LDR-Brachytherapy of Prostate Cancer: Impact of Post-Implant Dosimetry on the Intraoperative Procedure

Dr. med. Armin Thöni
Dr. phil. nat. Hans Neuenschwander
PD Dr. med. Jörn Wulf

Radio-Onkologie, Lindenhofspital
Permanent Prostate Brachytherapy (PPB) - Principle
LDR Brachytherapy – permanent implantation of I-125 Seeds

Single seeds (0.8 x 4.5 mm)

Iodine-125

• Low activity: 0.5 mCi (20 MBq)
• Low energy: 27-35 keV
• Half-life 60 days
Several different **implantation techniques** in PPB

- Preplanning with CT and implantation with TRUS-guidance
- Preplanning on ultrasound
- Intra-operative (real-time) planning and implantation on US
- Interactive, dynamic, intra-operative planning and implantation with TRUS

Peripheral loading vs homogenous loading
The last needle of the outer ring
Seeds on the fluoroscopy screen
Post-planning

Goals:

• Evaluation of the quality of the implant

• Detection of unfavourable dose distribution due to edema, seed loss or seed dislocation

6 weeks after implantation:

• **Fluoroscopy**: Seed-count

• **CT**: Identification of the seeds

• **MR**: Identification of prostate and rectum
Postplanning: dose distribution on MR
Post-planning:

3D-reconstruction
Post-planning: 3D-reconstruction
The role of the radio-oncology core team in PPB in our setting

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Patients

  - 115 low risk, 12 intermediate risk

- all treated with single seeds I-125 in one single session
- Prescription dose 145 Gy
- no combinations with EBRT
- only occasional antiandrogens (n = 7)

- 2004 (since 4.6.): 10 Pts
- 2005: 18 Pts
- 2006: 36 Pts
- 2007: 73 Pts
Post-planning-results (general)

- Seed loss / seed migration 0.6% (30/127 pts, mostly SV): no appreciable consequence on dosimetry

- no significant difference in prostate volume (based on MRI) compared to the volume at implant time
  \[ V(\text{post}) / V(\text{intra}) = 1.01 \pm 0.1 \]
Dosimetric goals for CTV

• **D90 > 145 Gy**  
  (Dose covering 90% of CTV)

• **V100 > 95%**  
  (% of CTV receiving prescription dose)

• **V150 < 65%**  
  (% of CTV receiving 150% of prescription dose)
Post-planning-results (CTV)

- D90 > 145 Gy (Dose covering 90% of CTV)
- V100 > 95% (% of CTV receiving prescription dose)
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<td>D90</td>
<td>163.9 Gy</td>
<td>131.8 - 202.9 Gy</td>
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<tr>
<td>V100</td>
<td>94.7 %</td>
<td>75.6 - 99.4 %</td>
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<tr>
<td>V150</td>
<td>62.3 %</td>
<td>34.6 - 83.7 %</td>
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- Problems in partially „cool“ implants: ventrally at base of prostate: normally not site of a tumour;
- no salvation procedures deemed necessary.
Post-Planning-Results (dosimetry)

• Relationship $D_{90}$ (post) / $D_{90}$ (intra)
  
  = quality marker for the precision of the implant:
  
  Goal as close as possible to 1

- 2005 & 2006: $0.86 \pm 0.08$
- 2007: $0.91 \pm 0.07$

  ➢ this difference is significant (p=0.0003)

• that allowed us to gradually decrease $D_{90}$ (intra) at implant time without compromising the quality of the implants
Other results

• Rectal dose: Goal V100 < 1.3 cc: not fulfilled in 15 / 127 pts (But: only 1 pt with rectal bleeding)

• Urethral dose: not evaluated in post-planning (3/127 pts with temporary suprapubic catheter)

• No obvious correlation between D90 (or other parameters) and postoperative urinary symptoms

• until now no biochemical failure

But still too early to present results on outcome (recurrence, toxicity)
Conclusions

• The quality of the PPB procedure and the resulting implants have been **improved over time**

• Post-implant dosimetry:
  ▪ **indispensable** for the proper **evaluation** of an implant
  ▪ **feedback** on the quality of the intra-operative procedure
  ▪ **hints** on adjustments for future implants
Conclusions

• Our local organizational procedure (radio-oncological core-team, multiple urologists) seems to be effective and could be recommended also for other centers.

• There is no difference in implant quality between a trained and an untrained urologist if guided by an experienced core team (physicist and radio-oncologist).
Outlook

- To overcome the problem of seed moving a few mm backwards during implantation:
  - Bard SourceLink® connector system
  - offers various selectable distances between sources