“LDR, HDR or PDR - crossroads”

Janusz Skowronek, MD, PhD, Asst. Prof.
Brachytherapy Department, Greater Poland Cancer Centre,
Electroradiology Department, University of Medical Sciences, Poznań, Poland

Brachytherapy of prostate cancer

Greater Poland Cancer Centre, Poznań
(2006 - 2014):

- HDR brachytherapy – 2398 applications
- Permanent implants (since 2008) – 83 patients
  
  (no reimbursement)

Permanent implants – first centre in Poland and Central Europe
Permanent LDR brachytherapy and temporary HDR brachytherapy are competitive techniques for clinically localized prostate radiotherapy.

Patients want to be cured by the least invasive method, those little risk of recurrence, lower risk of complications reported, and maintaining the high quality of life...
We like to treat prostate cancer – why?

- High incidence,
- Easy to treat (location, size, shape...),
- Very good results – symposia highlights,
- Very good results – patient’s satisfaction,
- Very good results – tribute for a hospital,
- Profitable method, money for a doctor,
- Interesting market for business...
USA disaster...


Aim: primary treatment trends focusing on the use of brachytherapy over time.

1. National Cancer Data Base (NCDB), a total of 1,547,941 patients with localized prostate cancer, from 1998 through 2010;
2. In the study cohort, brachytherapy use reached a peak of 16.7% in 2002, and then steadily declined to a low of 8% in 2010.
3. The most dramatic decline in BT was from academic centers - a decline of 48% compared to comprehensive community and community cancer centers.
4. Of the 719,789 patients with available data for risk stratification 41.1%, 35.3%, and 23.6%, respectively, met low, intermediate, and high NCCN risk criteria.

(2002) 16.7%  →  (2010) 8%


1. SEER database, where about 182,000 patients were treated between 2004-2009;
2. All BT used decreased from 44% in 2004 to 38% in 2009.
3. The difference in the utilization of EBRT monotherapy vs BT grew from 11.6% in 2004 to 24.0% in 2009.

(2004) 44%  →  (2009) 38%

USA disaster part II...

The reasons for a decline in BT usage are well discussed from both reports and includes:

1. An increase in number of prostatectomies:
   - 44% of treatment before the introduction of robotic prostatectomy in the early 2000s,
   - 60% of patients in 2010 (Martin et al.)

2. Advances of EBRT such as IMRT, SBRT, and protons.
   As discussed by Mahmood, a near complete transition from conventional EBRT to IMRT over the course of the past decade, from 0.15% in 2000 to 95.9% in 2008.

3. Reimbursement with IMRT and the development of URORAD centers.

4. Negative press with the VA debacle of prostate BT.

5. Suboptimal volume of prostate BT procedures for current radiation oncology residents which is supportive by the declining use of BT in academic centers.
Declining Use of Brachytherapy for the Treatment of Prostate Cancer
Usama Mahmood, Lawrence Levy, Gary Walker, Matthew Koshy, Thomas Pugh, Steven Frank, William Graber, Karen Hoffman, Deborah Kuban, Andrew Lee. Radiation Oncology, MD Anderson Cancer Center, Houston, TX; Radiation Oncology, University of Chicago, Chicago, IL; Urology, MD Anderson Cancer Center, Houston, TX.

Patterns of care for brachytherapy in Europe: Updated results
Feran Guedea, Jack Venselaar, Peter Hoskin, Tarun Paulsen Hellebust, Didier Peiffert, Bradley Londres, Montse Ventura, Jean Jacques Meezen, Erik Van Limbergen, Richard Potter, Gyorgy Kovacs
Radiotherapy and Oncology 27 (2010) 514–520

Fig. 3. Most common treatment localizations, group 1 (2002 vs. 2007).
BrachyNext

A FREE INTERNATIONAL CME SYMPOSIUM

Working together to shape the future of Brachytherapy

Prostate Cancer

RISK GROUP

EXPECTED PATIENT SURVIVAL

INITIAL THERAPY

ADJUVANT THERAPY

Active surveillance

• PSA no more often than every 6 mo unless clinically indicated
• DRE no more often than every 12 mo unless clinically indicated
• Repeat prostate biopsy no more often than every 12 mo unless clinically indicated

RT or brachytherapy

Adverse features:

• Radiation therapy

Progressive disease:

See Initial Clinical Assessment (PIUC-1)

• Lymph node metastasis ADT (category 1, 3 RT, category 2b), or Observation

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Discussion
PRINCIPLES OF RADIATION THERAPY

Primary External Beam Radiation Therapy (EBRT)

- Highly conformal RT techniques should be used to treat prostate cancer.
- Doses of 78.6 to 79.2 Gray (Gy) in 2 Gy fractions to the prostate (0.5 cm3) are usually prescribed for EBRT (1.8-2.0 Gy per fraction).
- Moderately hypofractionated image-guided IMRT regimens (2.4 to 2.8 Gy per fraction) have been tested in randomized trials and are considered a reasonable alternative to clinically acceptable regimens.
- Most patients with high-risk cancer are candidates for pelvic lymph node irradiation and the addition of neoadjuvant androgen deprivation ADT for a total of 2 to 3 years in duration.
- Patients with intermediate-risk cancer may be candidates for pelvic lymph node irradiation and 4 to 6 months of neoadjuvant androgen deprivation ADT.

Radiotherapy with Brachytherapy

- Permanent low-dose rate (LDR) brachytherapy as monotherapy is indicated for patients with low-risk cancer. For intermediate-risk cancers, consider combining brachytherapy with EBRT (45-50 Gy) + 4-16 8-10 Gy neoadjuvant/adjuvant ADT. Patients with high-risk cancers may be treated with a combination of EBRT (45-50 Gy) and brachytherapy (3 8-10 Gy neoadjuvant/adjuvant ADT).
- Patients with a very large prostate or very small prostate, symptoms of bladder outlet obstruction (BPO), or a previous transurethral resection of the prostate are more difficult to treat with brachytherapy and may require higher-dose external beam radiotherapy. Neoadjuvant ADT may be used to shrink the prostate to an acceptable size, however, increased toxicity would be expected from ADT and prostate size may not decline.
- Post-implant dosimetry must be performed to document the quality of the implant.
- The recommended prescribed doses for LDR monotherapy are 145 Gy for low-risk and 165 Gy for intermediat-risk. The recommended boost doses are 50 Gy EBRT to an 110 Gy and 90 to 105 Gy, respectively.
- High-dose rate (HDR) brachytherapy can be used alone or in combination with EBRT (45-50 Gy) instead of LDR. Commonly used boost regimens include 30 Gy in 10 doses at 3.0 Gy per fraction, and 4.8 to 6.0 Gy per fraction.

Radiation dose to the bladder and rectum: Each patient should receive a low dose of radiation to the bladder and rectum. The radiation dose depends on the original primary external beam dose and ranges from 108 to 116 Gy for LDR and 12 to 12 Gy x 2 fractions for HDR.

Note: All recommendations are category 3 unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.

Continued on next page
NCCN Guidelines Version 2.2013
Prostate Cancer

Compared to EBRT alone. Common boost doses include 9.5 to 11.5 Gy in 3 fractions, 5.5 to 7.5 Gy in 5 fractions, or 4.5 to 6.0 Gy in 4 fractions. A commonly used regimen for HDR treatment alone includes 13.5 Gy in 2 fractions.

Addition of ADT (2 or 3 years) to brachytherapy and EBRT is common for patients at high risk of recurrence. The outcome of concurrent treatment is excellent, with 8-year progression-free survival and disease-specific survival reaching 67% and 91%, respectively.

However, it remains unclear whether the ADT component contributes to outcome improvement. D’Amico and colleagues studied a cohort of 1342 patients with PSA over 20 ng/ml, and clinical T3a/T4a and/or Gleason score 8 to 10 disease. Addition of radiotherapy increased the advantage over brachytherapy alone. The use of all three modalities (brachytherapy-specific) is better compared to brachytherapy alone (adjusted HR: 0.33, 95% CI: 0.14-0.77). Other analyses did not find an improvement in failure rate when ADT was added to EBRT and HDR.

Two groups have observed a lower risk of urinary, cystectomy, and rectal pain with higher brachytherapy compared with EBRT (permanent blank implant). Vargas and colleagues reported that HDR brachytherapy results in a lower risk of erectile dysfunction than HDR brachytherapy.

Proton Therapy
Proton beams can be used as an alternative radiation source. The costs associated with proton beam facility construction and proton beam treatment are high. Two comparisons between men treated with proton beam therapy and EBRT show similar early toxicity rates. A single-center report of prospectively collected quality-of-life data 3 months, 12 months, and >2 years after treatment revealed significant problems with incontinence, bowel dysfunction, and impotence. Perhaps most concerning is that only 25% of men with normal erectile function maintained normal erectile function after therapy.

The NCCN panel echoed the following statement by ASTRO in its review of proton beam therapy: "Prostate cancer has the most patients treated with conformal proton therapy of any other disease site. The outcome is similar to IMRT therapy, however, with no clear advantage from clinical data for either technique in disease control or prevention of late toxicity. This is a site where further head-to-head clinical trials may be needed to determine the role of proton beam therapy. In addition, careful attention must be paid to the role of both treatment issues including correction for organ motion in this disease. Based on current data, proton therapy is an option for prostate cancer, but no clear benefit over the existing therapy of IMRT plutions has been demonstrated."

Radiation for Metastases
Radiation is an effective means of palliating bone metastases from prostate cancer. In May 2013, the Food and Drug Administration (FDA) approved raloxifene, an alpha-particle-emitting radiopharmaceutical. This is a faster radioactive therapeutic that was approved for treatment of metastatic carcinoma, recurrent prostate cancer, and/or CRPC in patients with symptomatic bone metastases and no known visceral metastatic disease. Approval was based on clinical data from a multicenter, phase III study that randomized patients over 623 mg with symptomatic CRPC, 2 or more bone metastases, and no known visceral disease. Fifty-seven percent of patients received prior docetaxel and all patients received best supportive care. Patients were randomized in a 2:1 ratio to 6 monthly raloxifene injections or placebo. Compared to placebo, raloxifene significantly improved overall survival (median 14.9 months vs. 11.3 months; HR, 0.53).

CLINICAL INVESTIGATION
Prostate

American Brachytherapy Society (ABS) Recommendations for Transperineal Permanent Brachytherapy of Prostate Cancer

Subir Nag, M.D.,†,‡ David Beyer, M.D.,‡,§ Jay Friedland, M.D.,‡,§ Peter Grimm, D.O.,‡,§ and Rayzinger Nathan, Ph.D.,‡,§,★

*Prostate Brachytherapy Quality Assurance Group, Clinical Research Committee, American Brachytherapy Society, Reston, VA; 1Ohio State University, Columbus, OH; 2Arizona Oncology Services, Phoenix, AZ; 3Memorial Sloan Kettering Cancer Center, New York, NY; 4Wendy Medical Center, Pittsburgh, PA; and 5Yale University, New Haven, CT

American Brachytherapy Society recommends no change for prostate permanent implant dose prescriptions using iodine-125 or palladium-103.
American Brachytherapy Society consensus guidelines for transrectal ultrasound-guided permanent prostate brachytherapy

ASTRO GUIDELINE
AMERICAN SOCIETY FOR RADIATION ONCOLOGY (ASTRO) AND AMERICAN COLLEGE OF RADIOLOGY (ACR) PRACTICE GUIDELINE FOR THE TRANSPERINEAL PERMANENT BRACHYTHERAPY OF PROSTATE CANCER

ESTRO/EAU/EORTC recommendations on permanent seed implantation for localized prostate cancer
Daniel Ash, Anthony Flynn, Jan Battermann, Theodorous de Reijke, Paolo Lavagnini, Leo Blank

Received 18 September 2000; accepted 27 September 2000
American Brachytherapy Society consensus guidelines for high-dose-rate prostate brachytherapy
Yoshiya Yamada1,*, Leland Rogers2, D. Jeffrey Demanes3, Gerard Morton4, Bradley R. Prestidge1, Jean Poulion5, Gil’ad N. Cohen7, Marco Zaider3, Mihai Ghilezan3, I-Chow Hsi9

ASTRO GUIDELINE
AMERICAN SOCIETY FOR RADIATION ONCOLOGY (ASTRO) AND AMERICAN COLLEGE OF RADIOLOGY (ACR) PRACTICE GUIDELINE FOR THE PERFORMANCE OF HIGH-DOSE-RATE BRACHYTHERAPY
Beth A. Erickson, M.D.,* D. Jeffrey Demanes, M.D.,1 Geoffrey S. Irby, PhD,1 John K. Hayes, M.D., M.S.,2 I-Chow J. Hsiu, M.D.,3 David E. Morris, M.D.,4 Rachel A. Rabinovitch, M.D.,5 Jonathan D. Tward, M.D.,Ph.D.,6,* and Seth A. Rosenthal, M.D.,11

GEC/ESTRO-EAU recommendations on temporary brachytherapy using stepping sources for localised prostate cancer
György Kovács8,*, Richard Pötter9, Tillmann Loch9, Josef Hammer9, Inger-Karine Kolkman-Deurloo9, Jean J.M.C.H. de la Rosette9, Hagen Bertermann9
### Inclusion Criteria:

**Clinical Stage:**

- **T1-T3b and selected T4**
- **T1b-T2c and selected T3**
- **T1b-T3b**

**Gleason Score:**

- **Gleason score 2-10**
- **Gleason scores 2-10**
- **Any Gleason score**

**PSA:**

- **No upper limit, but in almost all cases, patient does not have documented distant metastasis (T<sub>xN0M0)</sub>**
- **In almost all cases, a PSA ≤ 50 ng/mL**
- **Any iPSA without distant metastases**
- **No pathologic evidence of pelvic lymph node involvement**
- **No distant metastases**

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**ABS PROSTATE HIGH-DOSE RATE TASK GROUP**

I-Chow Hsu, MD, Yoshiya Yamada, MD, Eric Vigneault, MD, Jean Pouliot, PhD, August, 2008

**ABS PROSTATE LOW-DOSE RATE TASK GROUP**

Gregory S. Merrick, M.D., Michael J. Zelefsky, M.D., John Sylvester, M.D., Subir Nag, M.D., William Bice, Ph.D.

**GEC-ESTRO – High-Dose-Rate**

Gyorgy Kovacs, Richard Pötter, Tillmann Loch, Josef Hammer, Inger-Karine Kalkman-Deurloo, Jean J.M.C.H. de la Rosette, Hagen Bertermann, 2005
### Patient Selection Criteria:

#### Monotherapy:

- Clinical T1b-T2b and Gleason score ≤ 7 and PSA ≤ 10 ng/mL
- Clinical stage T1b-T2b and Gleason score ≤ 6 and PSA ≤ 10 ng/mL
- Select higher risk patients
- Salvage of select radiation therapy failures

#### Boost:

- ≥ clinical stage T2c and/or Gleason score ≥ 7 and/or PSA > 10 ng/mL
- Stages T1b–T3b
  - Any Gleason score
  - Any iPSA without distant metastases

#### Special clinical situations:

Inadequate information exists to recommend supplemental XRT based on perineural invasion, percent positive biopsies and/or MRI-detected extracapsular penetration

### Exclusion Criteria:

#### Relative Contraindications:

- Severe urinary obstructive symptoms
- Extensive TURP defect or TURP within 6 months
- Collagen vascular disease
- Severe urinary irritative/obstructive symptomatology
- Substantial median lobe hyperplasia
- Prostate dimensions larger than the grid (i.e., > 60 mm in width and > 50 mm in height)
- Severe pubic arch interference
- Gross seminal vesicle involvement
- Prior pelvic radiotherapy
- Inflammatory bowel disease
- Pathologic involvement of pelvic lymph nodes
- Volume > 60 cm³
- TURP within 6 months
- Infiltration of the external sphincter of the bladder neck
- Significant urinary obstructive symptoms
- Pubic arch interference
- Rectum-prostate distance on TRUS < 5 mm
- Large median lobes
- Gland size < 60 cm³ at time of implantation
- Inflammatory bowel disease

#### Absolute Contraindications:

- Unable to undergo anesthesia (general, spinal, epidural, or local)
- Unable to lay flat
- Limited life expectancy
- Unacceptable operative risks
- Distant metastases
- Large TURP defects, which preclude seed placement and acceptable radiation dosimetry
- Ataxia telangiectasia
### Doses

#### Monotherapy

<table>
<thead>
<tr>
<th>ABS PROSTATE HIGH-DOSAGE RATE TASK GROUP</th>
<th>ABS PROSTATE LOW-DOSAGE RATE TASK GROUP and ESTRO/EAU/EORTC Low-Dose Rate</th>
<th>ABS consensus guidelines for transrectal ultrasound-guided permanent prostate brachytherapy <em>Davis BJ et al.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pd-103</td>
<td>Pd-103</td>
</tr>
<tr>
<td>10.5 Gy x 3</td>
<td>125 Gy (110-120 Gy)</td>
<td>110-125 Gy</td>
</tr>
<tr>
<td>8.5-9.5 Gy x 4</td>
<td>145 Gy (140-160 Gy)</td>
<td>140-160 Gy</td>
</tr>
<tr>
<td>6.0-7.5 Gy x 6</td>
<td>Cs-131 115 Gy</td>
<td>140-160 Gy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pd-103</td>
<td>I-125</td>
</tr>
<tr>
<td>9.5-10.5 Gy x 2 (with 40-50 Gy XRT)</td>
<td>Boost (with 41.4 – 50.4 Gy EBRT) 90-100 Gy</td>
<td></td>
</tr>
<tr>
<td>5.5-7.5 Gy x 3 (with 40-50 Gy XRT)</td>
<td>Boost (with 41.4 – 50.4 Gy EBRT) 108-110 Gy</td>
<td></td>
</tr>
<tr>
<td>4.0-6.0 Gy x 4 (with 36-50 Gy XRT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### BT + EBRT

| Pd-103 | Boost (with 41.4 – 50.4 Gy EBRT), 1.8 – 2.0 Gy/fr. 108-110 Gy |

### PTV

The definition of volumes will be in accordance with ICRU Report 58: Dose and Volume Specification for reporting interstitial therapy.

- Clinical Target Volume (CTV) is defined by the physician on the treatment planning scan.
- For T1c-T2b, the brachytherapy CTV includes the prostate only
- For T3a-T3b, the brachytherapy CTV includes the prostate and extra-capsular extension.

- PTV = CTV.
- Prostate with margin
- Seminal vesicles
- Prostate minus non-cancerous regions of the gland (e.g., anterior base)
- Image-guided target volumes such as indium-111 or MR spectroscopy
**Recommended evaluated postoperative dosimetric parameters:**

- The prescription dose will be given only to the PTV.
- The goal is to deliver the prescription dose to at least 90% of the PTV (V100 prostate >90%).
- The volume of bladder and rectum receiving 75% of the prescription dose should be kept to less than 1 cm³ (V75 bladder < 1 cm³).
- The volume of urethra receiving 125% of the prescription dose should be kept to less than 1 cm³ (V125 urethra < 1 cm³).

**Current dose fractionation schedules**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Dose Fractionation</th>
<th>Bladder</th>
<th>Urethra</th>
<th>Rectum</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSKCC</td>
<td>Boost 7 Gy x 3</td>
<td>Mono 9.5 Gy x 4</td>
<td>&lt; 120% prescription D2&lt;170%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mono 9.5 Gy x 4</td>
<td>Salvation 8 Gy x 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UCSF</td>
<td>Boost 15 Gy x 1</td>
<td>Mono 10.5 Gy x 3</td>
<td>V15&lt;1 cc</td>
<td>V15&lt;1 cc, V15=0 cc</td>
</tr>
<tr>
<td></td>
<td>Mono 9.5 Gy x 4</td>
<td>Salvation 8 Gy x 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBH</td>
<td>Boost 10.5 Gy x 2</td>
<td>Mono 4 x 9.5 Gy (historical)</td>
<td>No constraint (intra-op TRUS-based dose)</td>
<td>V100=90% of prescription V15&lt;1% of prescription</td>
</tr>
<tr>
<td></td>
<td>12-13.5 Gy x 2 (current)</td>
<td>Salvation 7 Gy x 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combined with hyperthermia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCC</td>
<td>Boost 6 Gy x 2</td>
<td>2 implants</td>
<td>&lt; 80% of Rx</td>
<td>&lt; 80% of Rx to outer wall</td>
</tr>
<tr>
<td></td>
<td>Mono 6 Gy x 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mono two sessions of 6.5 Gy x 3</td>
<td>&lt; 100% prescription</td>
<td>&lt; 100% prescription</td>
<td>mucosa &lt; 60%, outer wall &lt; 100%</td>
</tr>
<tr>
<td>GW</td>
<td>Boost 6.5 Gy x 3</td>
<td>Mono 15 Gy x 3</td>
<td>&lt; 100% prescription</td>
<td>&lt; 100% prescription</td>
</tr>
<tr>
<td></td>
<td>Mono 6 Gy x 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>90 - 100% wall 80% balloon</td>
<td>120% combo 105% any TUR 110% mono</td>
<td>Rectal wall 80% Rectal wall 80 – 85%</td>
<td></td>
</tr>
<tr>
<td>Toronto</td>
<td>Boost 6 Gy x 3</td>
<td>Mono 7.25 Gy x 4</td>
<td>D2&lt;118% Max &lt; 25%</td>
<td>VBO &lt; 0.5 cc</td>
</tr>
<tr>
<td></td>
<td>120 Gy x 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HDR & LDR & PDR Brachytherapy: Diagnostics, Equipment, Personnel – the same

Team

Experience in:

1. TRUS (done by radiotherapist, urologist?),
2. Dosimetry, treatment planning,
3. Needles (seeds) implantation (radiotherapist),
4. Radiotherapy knowledge.

Team:
1. radiation oncologist,
2. urologist, radiologist or radiation oncologist with US skills,
3. physicist,
4. 2-3 nurses,
5. anesthetist,
6. nurse anesthetic,
7. X-ray technician.
### PDR

**Author N= EBRT PDR Follow-up Results Complications**

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>EBRT</th>
<th>PDR</th>
<th>Follow-up</th>
<th>Results</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geiger MH et al. (Erlangen), 2005</td>
<td>91</td>
<td>T1-2 45 Gy T3 – 50,4 Gy</td>
<td>25 Gy (0,6 Gy/h) – 26 pts 30 Gy (0,65 Gy/h) – 59 pts</td>
<td>18 months</td>
<td>9% - recurrence</td>
<td>11% - urinary</td>
</tr>
<tr>
<td>Ploetz B et al. (Amsterdam), 2005</td>
<td>27</td>
<td>46 Gy</td>
<td>29 Gy (1,0 Gy/h)</td>
<td>3 months</td>
<td>Low toxicity – 17,4% GU in 12 week</td>
<td></td>
</tr>
<tr>
<td>Izard MA et al. (IJORB 2006)</td>
<td>165</td>
<td>50,4 Gy</td>
<td>18 Gy in 3 fractions (6h interval), 0,5-1,0 Gy/h</td>
<td>36 months</td>
<td>98% - CSS 93% - OS</td>
<td></td>
</tr>
<tr>
<td>Lettmaler S et al. (RO 2012)</td>
<td>130</td>
<td>50,4 Gy</td>
<td>25 Gy – 33 pts 30 Gy – 63 pts 35 Gy – 34 pts (1 session, 0,6-0,7 Gy/h/24 pulses</td>
<td>60 months</td>
<td>85,6% - DFS 15% - GI 1/2 grade 15% - GU 1/2 grade</td>
<td></td>
</tr>
<tr>
<td>Pieters B et al. (IJORB 2011)</td>
<td>110</td>
<td>46 Gy</td>
<td>24,96-28,80 Gy</td>
<td>60 months</td>
<td>99% - 3 yrs 96% - 5 yrs 12% - GI grade 2 26,9% - GU grade 2</td>
<td></td>
</tr>
</tbody>
</table>
## PDR

### PDR monotherapy

<table>
<thead>
<tr>
<th>Author</th>
<th>N=</th>
<th>PDR</th>
<th>Follow-up</th>
<th>Results</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geiger MH et al.</td>
<td>16</td>
<td>65 Gy in 2 fractions, 0.65 Gy/h/24 pulses</td>
<td>(12 months)</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Lahmer G et al.</td>
<td>18 recurrence</td>
<td>30 Gy, 2 fractions (0.6 Gy/h/24 pulses)</td>
<td>36 months</td>
<td>88.9% - OS 57.1% - PSA RFS</td>
<td>11.1% GU 2 16.7% GU 3</td>
</tr>
</tbody>
</table>

### PDR - Erlangen schedules

- **T1-2cN0M0, PSA < 10, Gleason < 7, V < 60 cm3**
  - sole PDR, 2 x 35 Gy, 0.70 Gy/h

- **T2b-c N0M0, PSA < 10, Gleason < 7, V < 60 cm3**
  - EBRT 50.4 Gy and PDR „boost” 35 Gy, 0.70 Gy/h

- **T3, PSA < 10, Gleason < 7, V < 60 cm3**
  - EBRT 50.4 Gy, hormonal therapy and PDR „boost” 35 Gy, 0.70 Gy/h
Seeds LDR brachytherapy - Advantages over HDR

• Large worldwide clinical experience and long-term data available,
• Patient and Doctor convenience,
• One-day patient turnover,
• Ideal for patients with pre-existing comorbidities precluding prolonged hospitalization,
• Ideal for patients with AUA scores of <12.

Seeds LDR brachytherapy - Disadvantages over HDR

• Dosimetric uncertainties regarding final seeds distribution and dosimetry (gland swelling, seeds migration, clumping),
• No accurate post-implant plan in the OR since individual seed position identification is not yet possible,
• Dosimetry (CT) is performed after patient leaves the OR,
• Real implant dosimetry varies with time from procedure (“cold implants” until prostate edema subsides, seeds migration/clumping may add to dose inhomogeneity over effective treatment time (6 months for I-125).
Seeds LDR brachytherapy - Disadvantages over HDR

- Operator-dependent and patient volume-dependent to maintain expertise
- Longer resolution of urinary symptoms

Acute urinary toxicity

Seeds LDR brachytherapy - Disadvantages over HDR

- Less likely to preserve erectile function
Seeds

**Sole LDR brachytherapy:**

**Advantages**
- good treatment results (similar to surgery)
- relatively small rate of complications
  - short treatment time (1-3 days)

**Disadvantage**
- in the past – seed migration possibility
- small risk of relatives irradiation
  - costs

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**HDR**

**Advantages**
- good treatment results (similar to seeds)
  - possibility of dose verification
  - complications similar to
    - positive radiobiology
  - no staff exposure to radiation

**Disadvantage**
- different fractionation schemas
- in monotherapy – small trial’s number
HDR

**Advantages**

1. **Radiation protection:**
   - HDR eliminates radiation exposure hazard for caregivers and visitors
   - eliminates source preparation and transportation
   - minimal risk of losing a radioactive source

2. **Allows shorter treatment times:**
   - less patient discomfort
   - to treat patients who may not tolerate long periods of isolation
   - less risk of applicator movement
   - reduced hospitalization costs
   - possible to treat a larger number of patients

3. **HDR sources are of smaller diameter than the other sources:**
   - allows for interstitial, intraluminal, and percutaneous insertions.

4. **HDR makes treatment dose distribution optimization possible:**
   - variations of the dwell times of a single stepping source and the source position

**Disadvantages**

1. **Radiobiological:**
   - The short treatment times do not allow for the repair of sublethal damage in normal tissue or the redistribution of cells within the cell cycle or reoxygenation

2. **Limited experience:**
   - In US

3. **The economic disadvantage:**
   - a large initial capital expenditure since the remote afterloaders cost
   - additional costs for a shielded room and personnel costs are higher

4. **Greater potential risks:**
   - greater potential harm if the machine malfunctions or if there is a calculation error.
   - the short treatment times, compared to LDR, allow much less time to detect and correct errors.

**Conclusions**

At present, the available clinical data with these two techniques suggests that they are equally effective, stage for stage, in providing high tumor control rates.
Conclusions

Easily money can decide on the treatment of patients and not the curability or quality of life after treatment.

Our choice...
Thank you