"Role of brachytherapy in radiotherapy system in Poland. Practical prostate cancer brachytherapy."

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Trends

- Seeds – prostate, breast, lung, HAN, others,
  - PDR brachytherapy,
  - Image-based 3D planning,
  - Intraoperative brachytherapy,
- Intensive Modulated brachytherapy,
- New applicators and techniques,
  - Electronic brachytherapy,
- Quality Assurance, Quality of Life.
Population: 37.5 millions

Radiotherapy centers: 30 (3 privat), 3-4 built (privat)

include:

Brachytherapy departments, laboratories: 28 (3 privat)

EBRT accelerators: 111 (min. 10-15% to exchange)
- Co-60 5 (withdrawning)
- Linear accelerators 106 (2 Mobetrons, 2 Cybekenife)
- Simulators 43

(ultimately planned - 140-150 accelerators)

1/250 000 inhabitans
Brachytherapy units: 41

LDR(MDR): 1 (22 in 2002) withdrawn now
HDR: 35 (14 in 2002)
  Nucletron - 34, IBt Bebig - 1
PDR: 6 (4 in 2002)

Seeds: Poznań, Warszawa, Jastrzębie Zdrój

Reimbursement – 2012?
Radiotherapy in Poland - 2011

- External Beam Radiation Therapy – 63646 patients
- Brachytherapy – 9880 pts (15.5%)

Total – 73526 patients

- Morbidity (estimated) – 150-160 000 (?)
- 28/30 of RT centres use BT:

  - GCC Poznań 1159
  - Gliwice 926
  - Kielce 908
  - Bydgoszcz 882
  - Warszawa 637
## Radiotherapy in Poland - 2011

### New patients yearly

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>External Beam Radiotherapy</td>
<td>57826</td>
<td>63646</td>
</tr>
<tr>
<td>Brachytherapy</td>
<td>9218 (15,9%)</td>
<td>9880 (15,5%)</td>
</tr>
</tbody>
</table>

- **External Beam Radiotherapy** increased by 10% from 57826 to 63646.
- **Brachytherapy** increased by 7,2% from 9218 to 9880.
Radiotherapy in Poland - 2011

Physicians (2008):
radiotherapy specialists – 379
in training – 123

Physicians (2011): 18%
radiotherapy specialists – 431
brachytherapy – 50-70?
in training – 160
1. Largest number of patients treated with BT in Poland,

2. The largest case number of:
   - prostate
   - lung,
   - oesophagus,
   - breast,
   - head and neck,
   - skin cancers.

3. gynaecology - third place in Poland,


5. Interstitial Hyperthermia with BT,

6. APBI, HDR prostate monotherapy – routine,

7. Endovascular BT - history.
Radical brachytherapy:

- prostate cancer
- skin cancer
- breast cancer
- gynaecological cancers
- anal cancer
- head and neck cancer ~ 50%
- rarely: lung cancer ~ < 5%
  oesophageal cancer ~ < 5%
- restenosis in femoro-popliteal arteries and in coronary arteries (history)

Palliative brachytherapy:

- pancreas, bile duct cancer
- oesophageal cancer
- lung cancer
- head and neck cancer ~ 50%
- brain tumors (history)
3 shielding rooms:

- PDR,
- HDR I + SWIFT,
- HDR II + IBU (Simulix),

Operating room + SWIFT/SPOT,
Laboratory of Treatment Planning and Brachytherapy Dosimetry
Bronchoscopy laboratory,
Hyperthermia laboratory,
Out-patient Clinic,
2 wards (6 beds),
Duty-room,
Nurse’s station.
• Microselectron HDR V3 – 2009
• Microselectron HDR classic – 2001/2008 (V3)
• Microselectron PDR – 1999 (new in 2012)
• Hyperthermia BSD-500 – 2006
• Phillips Endura RTG – 2006
• Simulix Evolution - 2011

• PLATO vs. 14.1.3. – 2006
• Oncentra gynaecology, Oncentra Masterplan – 2008
• SWIFT „real-planning” System - 2006
• SWIFT/SPOT Combo planning system – 2008

• Seeds - 2008

• Oncentra 4.0 - 2011
Operating room
Team

- Physicians - 3 radiotherapy specialist
  - 4 (in training),
  - 1 pulmonologist (consultant),
- Physicists - 4
- X-ray technicians - 2
- Treatment nurses - 5
- Ward nurses - 8
- Secretary - 2
- Anesthetist - 1
- Nurse anesthetic - 1 - 2
Prostate cancer as example
Brachytherapy of prostate cancer

Greater Poland Cancer Centre (2006 - 2011)

HDR brachytherapy – 1610 procedures

Permanent implants – 63 patients (since December 2008)

Permanent implants – first centre in Poland!

Implants - nowadays:

2 oncological centres (Poznań, Warsaw),
1 private centre (Jastrzębie Zdrój) – no data
Greatest problems...

Impotence

Urinary incontinence
Prostate cancer - morbidity, mortality in Poland

<table>
<thead>
<tr>
<th>Year</th>
<th>Morbidity - Poland</th>
<th>Mortality - Poland</th>
<th>Mortality - Greater Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>5049</td>
<td>3147</td>
<td>308</td>
</tr>
<tr>
<td>2001</td>
<td>5391</td>
<td>3365</td>
<td>338</td>
</tr>
<tr>
<td>2002</td>
<td>5236</td>
<td>3488</td>
<td>331</td>
</tr>
<tr>
<td>2003</td>
<td>5832</td>
<td>3390</td>
<td>305</td>
</tr>
<tr>
<td>2004</td>
<td>6257</td>
<td>3578</td>
<td>325</td>
</tr>
<tr>
<td>2005</td>
<td>7095</td>
<td>3592</td>
<td>330</td>
</tr>
<tr>
<td>2006</td>
<td>7154</td>
<td>3681</td>
<td>310</td>
</tr>
<tr>
<td>2007</td>
<td>7638</td>
<td>3932</td>
<td>377</td>
</tr>
<tr>
<td>2008</td>
<td>8268</td>
<td>3892</td>
<td>360</td>
</tr>
</tbody>
</table>
Brachytherapy cases done in the USA

USA
## Prostate cancer

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity</td>
<td>217.730</td>
<td>240.000</td>
<td>8.268</td>
</tr>
<tr>
<td>Mortality</td>
<td>32.050</td>
<td>85.000</td>
<td>3.892</td>
</tr>
</tbody>
</table>

Japan – 15.1/100.000  
Sveden – 81.8/100.000

* Ca Cancer J Clin, 2010  
* PCBE Reports, Guedea, RO 2010
Patterns of care for brachytherapy in Europe: Updated results
Ferran Guedea, Jack Venselaar, Peter Hoskin, Taran Paulsen Hellebust, Didier Peiffert, Bradley Londres, Montse Ventura, Jean-Jacques Mazeron, Erik Van Limbergen, Richard Pötter, Gyorgy Kovacs
Radiotherapy and Oncology 97 (2010) 514–520

Fig. 3. Most common treatment localizations, group 1 (2002 vs. 2007).
Prostate cancer 2007 (17% of BT in Europe)

- gynaecological (59%), prostate (17%), breast (9%), lung/bronchus (3%), and esophagus (2%).

In group I

- the five most common tumor sites were as follows: gynaecological (48%), prostate (26%), breast (12%), eye (3%), and esophagus (2%).

Greater Poland Cancer Centre (2009)

Gynaecological 371 (26.6%),
non-gynaecological 1024 (73.4%)
prostate 322 (23.1%)
Radical prostatectomy

or

External beam irradiation
10 - 20 YEARS AGO

Radical prostatectomy
or
Conventional external beam
or
Conformal external beam
or
Brachytherapy
or
Brachytherapy/external beam
ABS Prostate High-Dose Rate Task Group,
ABS Prostate Low-Dose Rate Task Group

brachytherapy guidelines

- HDR Radiobiologic Dose Equivalent Worksheets #1 / Instructions
- HDR Radiobiologic Dose Equivalent Worksheets #2 / Instructions
- Cervical Cancer Brachytherapy Task Group
- ABS Breast Brachytherapy Task Group
- ABS Prostate High-Dose Rate Task Group
- ABS Prostate Low-Dose Rate Task Group
ESTRO/EAU/EORTC recommendations on permanent seed implantation for localized prostate cancer

Daniel Ash\textsuperscript{a,},*, Anthony Flynn\textsuperscript{b}, Jan Battermann\textsuperscript{b}, Theodorous de Reijke\textsuperscript{c}, Paulo Lavagnini\textsuperscript{d}, Leo Blank\textsuperscript{e}

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<table>
<thead>
<tr>
<th></th>
<th>Recommended Do well</th>
<th>Optional Fair</th>
<th>Investigational Do poorly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PSA (ng/ml)</strong></td>
<td>&lt; 10</td>
<td>10-20</td>
<td>&gt;20</td>
</tr>
<tr>
<td><strong>Gleason score</strong></td>
<td>5-6</td>
<td>7</td>
<td>8-10</td>
</tr>
<tr>
<td><strong>Stage</strong></td>
<td>T1c-T2a</td>
<td>T2b-T2c</td>
<td>T3</td>
</tr>
<tr>
<td><strong>IPSS</strong></td>
<td>0-8</td>
<td>9-19</td>
<td>&gt;20</td>
</tr>
<tr>
<td><strong>Prostate volume (g)</strong></td>
<td>&lt;40</td>
<td>40-60</td>
<td>&gt;60</td>
</tr>
<tr>
<td><strong>Q_{\text{max}} \text{ ml/s}</strong></td>
<td>&gt;15</td>
<td>15-10</td>
<td>&lt;10</td>
</tr>
<tr>
<td><strong>Residual volume \text{ cm}^3</strong></td>
<td></td>
<td></td>
<td>&gt;200</td>
</tr>
<tr>
<td><strong>TURP</strong></td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Risk categories (N0 M0) – Clinically localized

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Intermediate</th>
<th>High</th>
<th>Very high, locally advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T</strong></td>
<td>1-2a</td>
<td>2b, 2c</td>
<td>3a</td>
<td>3b, 4</td>
</tr>
<tr>
<td><strong>PSA</strong></td>
<td>&lt; 10</td>
<td>10-20</td>
<td>&gt;20</td>
<td>Any</td>
</tr>
<tr>
<td><strong>Gleason score</strong></td>
<td>&lt; 7</td>
<td>7</td>
<td>&gt;7</td>
<td>any</td>
</tr>
</tbody>
</table>

### Metastatic: any T, N1 M0
- any T, any N, M1

### Very low
- PSA < 10 ng/ml
- Gleason < 6
- density PSA < 0.15 ng/ml/g, below 3 wałeczków z biopsji zajętych w każdym poniżej 50 % nacieku
Contraindications

ESTRO/EAU/EORTC RECOMMENDATIONS ON PERMANENT SEED IMPLANTATION FOR LOCALISED PROSTATE CANCER

1. expected survival time < 5 years (?),

2. metastasis,

3. TURP in the past with considerable damage to the prostate (<3 months ?),

4. persistent hematuria, the regular use of aspirin or anticoagulants,

5. prostate volume > 60 cm cc (HT!).
Brachytherapy in Poland - 2011

Temporary - HDR
GEC/ESTRO-EAU recommendations on temporary brachytherapy using stepping sources for localised prostate cancer

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Available online 22 October 2004
## Prostate brachytherapy in Poland

<table>
<thead>
<tr>
<th>Centre</th>
<th>2004</th>
<th>2006</th>
<th>2007</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kraków</td>
<td>0</td>
<td>36</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>Poznań</td>
<td>0</td>
<td>70</td>
<td>229</td>
<td>307 + seeds (15)</td>
</tr>
<tr>
<td>Białystok</td>
<td>0</td>
<td>5</td>
<td>31</td>
<td>36</td>
</tr>
<tr>
<td>Gliwice</td>
<td>67</td>
<td>67</td>
<td>44</td>
<td>36</td>
</tr>
<tr>
<td>Bydgoszcz</td>
<td>71</td>
<td>107</td>
<td>80</td>
<td>89</td>
</tr>
<tr>
<td>Brzozów</td>
<td>43</td>
<td>30</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Kielce</td>
<td>24</td>
<td>30</td>
<td>30</td>
<td>52</td>
</tr>
<tr>
<td>Warszawa</td>
<td>93</td>
<td>87</td>
<td>114</td>
<td>94 + seeds (10)</td>
</tr>
<tr>
<td>Jastrzębie Zdrój (private)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>seeds (14)</td>
</tr>
<tr>
<td>Wieliszew (private)</td>
<td></td>
<td></td>
<td></td>
<td>starts HDR 2011</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>298</td>
<td>432</td>
<td>582</td>
<td>662</td>
</tr>
</tbody>
</table>
Monotherapy (ABS, GEC-ESTRO)

1. T1 i T2,
2. N0,
3. M0,
4. PSA <10, Gleason ≤6,
5. > 5 years life expectancy
HDR brachytherapy: diagnostic, equipment, team

similar to seeds
Team in Poznań

Experience in:

- TRUS (done by radiotherapist),
- dosimetry, treatment planning (physicist and radiotherapist),
- needles (seeds) implantation (radiotherapist and physicist),
- radiotherapy knowledge.

Team:

- radiotherapist,
- urologist, radiologist or radiotherapist with ultrasound skills,
- physicist,
- 2-3 nurses,
- anesthetist,
- nurse anesthetic,
- X-ray technician.
Brachytherapy - equipment

High quality - image guided source placement - SWIFT

• High quality digital TRUS with template software,
• Stepper, stepping unit,
• Treatment planning system,
• X-ray/CT for post-implant dosimetry.
HDR
Stepper with US head
SWIFT
Planning system
Different Target and Treatment Philosophies:

CTV 1 → Prostate Capsule
CTV 2 → Peripheral Zone
CTV 3 → Visible Tumor Infiltration
“Virtual planning”
“Real-time planning”
Brachytherapy as a Boost to EBRT:

- T2b, T2c or
- Gleason 8-10 or
- PSA > 20 ng/ml

Other possible indications for Brachytherapy as a Boost to EBRT:

- Perineural invasion,
- Multiple positive biopsies, bilateral positive biopsies,
- MRI positive for capsular penetration.

Brachytherapy (including Boosting EBRT) in Conjunction with Androgen Deprivation:

- Patients with initially large prostate (>60 cc) that have downsized sufficiently
AMERICAN BRACHYTHERAPY SOCIETY (ABS) RECOMMENDATIONS FOR TRANSPERINEAL PERMANENT BRACHYTHERAPY OF PROSTATE CANCER


*Prostate Brachytherapy Quality Assurance Group, Clinical Research Committee, American Brachytherapy Society, Reston, VA; †The Ohio State University, Columbus, OH; ‡Arizona Oncology Services, Phoenix, AZ; §Moffitt Cancer Center, Tampa, FL; ¶Swedish Medical Center, Seattle, WA; and ‖Yale University, New Haven, CT
ESTRO/EAU/EORTC recommendations on permanent seed implantation for localized prostate cancer

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\textsuperscript{e}Department of Radiotherapy, Free University, Amsterdam, The Netherlands

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Example of seed
Utrecht technique – used in 2008-2009
Seeds - producers

Greatest:
1. McMaster University's Reactor (Canada),
2. National Research Universal (NRU) Reactor (Canada)

1. IsoRay Medical™, Cesium-131
2. Best Medical International, Inc.
   Best Industries Iridium (Ir 192)
   3. Theragenics TheraSeeds
      Iodine-125, Palladium-103
4. Amersham Healthcare Iodine (I-125)

1. IBt Bebig
2. Nucletron
3. Varian VariSeed
4. Oncura RAPID Strand
5. BARD ProSeed
6. IsoAid
Doses:

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Dose Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-125 monotherapy</td>
<td>140-160 Gy</td>
</tr>
<tr>
<td>I-125 + 40-50 Gy EBRT</td>
<td>100-120 Gy</td>
</tr>
<tr>
<td>Pd-103 monotherapy</td>
<td>110-120 Gy</td>
</tr>
<tr>
<td>Pd-103 + 50 Gy EBRT</td>
<td>60-90 Gy</td>
</tr>
<tr>
<td>Cs-131 monotherapy</td>
<td>115 Gy</td>
</tr>
</tbody>
</table>
Greater Poland Cancer Centre

57 patients (50 – 82 years)

43 – Rapid Strands (USA); 14 – BEBIG (Germany)

Age:

- 50 – 59: 17
- 60 – 69: 28
- 70 – 79: 10
- ≥ 80: 2

Median: 63.8 years
55 patients – monotherapy
2 patients – recurrence after EBRT

T1 – 32
T2 – 25

Gleason:
≤ 6 – 45
7 – 12

PSA: median 9.2 ng/ml
< 10 ng/ml - 44
> 10 ng/ml - 13
Median seeds number - 53
Range: 30 – 82
21 patients – 40 - 50
18 patients – 51 - 60

Median needles number: 23
Range: 15 – 34

Median prostate volume: 32.5 cm³
Range: 14 – 62 cm³

Severe complications: 1 patients – urinary retention
Post implant dosimetry

It is usual to perform the CT scan 4±6 weeks after implantation when oedema has settled.

It is recommended that the following indices are recorded for all patients:

1. The volume implanted.
2. The number of seeds.
3. The number of needles used.
4. The total activity implanted.
5. The prescribed dose.
6. The D90, that is the dose that covers 90% of the prostate volume as defined from post implant imaging.
7. The V100, that is the percentage of the prostate volume that has received the prescribed dose.
8. V150, the volume that has received 50% more than the prescribed dose.
Cumulative treatment costs over five and a half years for patients with newly-diagnosed prostate cancer.\textsuperscript{14}
Costs

P-BIG Prostate Brachytherapy International Group
Luis A. Linares MD FACRO, EJGH, LA
Seeds

Sole LDR brachytherapy:
Advantages

- good treatment results (similar to surgery) \(^1,2\)
- relatively small rate of complications
- short treatment time (1-3 days)

Disadvantage

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

HDR

Advantages

• good treatment results (similar to seeds) ¹,²
  • possibility of dose verification
  • complications similar to ¹)
  • positive radiobiology
  • no staff exposure to radiation

Disadvantage

• different fractionation schemas
  • in monotherapy – small trial’s number

Thank you for your attention