Image Guided Focal Prostate Cancer Therapy

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• Research lab @ National Institutes of Health and Philips have a CRADA (Cooperative Research and Development Agreement) which resulted in the development of UroNav (MRI - TRUS prostate fusion biopsy system)
NIH Research Team

• Molecular Imaging
  – Peter Choyke, M.D.
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  – Tom Pohida, PhD
  – Dagane Daar

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• Biometric Research Branch

• Pathology
  – Maria Merino, M.D.
Current State of Focal Therapy
Current State of Focal Therapy

- Prostate cancer focal therapy is like the Wild West
  - No rules govern its use regarding patient selection
  - FDA approved devices for whole gland prostate or "tissue" ablation are being used
  - Urology struggles to "police" focal tx since other medical disciplines are offering this to patients
Treatment Methods for Localized Prostate Cancer

• Surgery
  – Retropubic Prostatectomy
  – Perineal Prostatectomy
  – Laparoscopic Prostatectomy
  – Robotic Assisted Prostatectomy

• Radiation Therapy
  – External Beam
  – Proton Beam
  – Interstitial Seed Implantation

• Ablation (Cryo / Heat, HIFU, Laser, PDT)

• Active Surveillance
Prostate Cancer Treatment

• Radical treatment (surgery or radiation)
  – Results in known harms that may not outweigh the potential benefit
• Concern is overtreatment
• Patients and physicians seeking less morbid treatment modalities today such as focal therapy
• Fear is standard TRUS biopsy underestimates tumor volume and grade
RATIONALE FOR FOCAL THERAPY

• Middleground for patients faced with AS or radical therapy
• Tissue preserving strategy employed in renal, thyroid, breast, liver, and pancreatic Ca
• Though PCa is multifocal, natural history driven by index lesion

Ahmed et al. European Urology 2015
PATIENT SELECTION

• In 2015, an expert consensus panel agreed patients with low and intermediate risk PCa are candidates
• Multifocality does not preclude focal therapy
  – Index lesion is targeted since it drives the natural history of the disease

Donaldson et al. European Urology 2015
CANCER LOCALIZATION

• Standard TRUS biopsy inadequate for estimating cancer focus

• Lesions may be localized by:
  – Multiparametric MRI
  – MRI-TRUS fusion guided biopsy
  – Transperineal template-mapping biopsy

Donaldson et al. European Urology 2015
Clinical-Pathologic Correlation Between Transperineal Mapping Biopsies of the Prostate and Three-Dimensional Reconstruction of Prostatectomy Specimens

E. David Crawford, 1 Kyle O. Rove, 1 Al B. Barqawi, 1 Paul D. Maroni, 1 Priya N. Werahera, 2 Craig A. Baer, 3 Hari K. Koul, 1 Cory A. Rove, 4 M. Scott Lucia, 2 and Francisco G. La Rosa 2*

- 25 men had 1,403 needle cores taken
- Results correlated with computer models of 3D whole mounted RRP specimens
- Total of 64 tumors identified
- 18/64 tumors missed by TPMB but only 1 was clinically significant
59 y.o. PSA=6 ng/mL, with prior negative TRUS biopsy

Gleason 3+4
Prostate Cancer is Multifocal

- 83% of patients exhibit multifocality
- Index cancers much larger than secondary tumors

Wise et al. Urology 2002
# Does size matter?

<table>
<thead>
<tr>
<th>Insignificant</th>
<th>Significant but curable</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.2 cm³</td>
<td>&gt; 0.5 cm³</td>
<td>&gt; 0.5 cm³</td>
</tr>
<tr>
<td>Gleason 1-3</td>
<td>Gleason 4-5</td>
<td>Gleason ≥6</td>
</tr>
<tr>
<td>confined</td>
<td>microscopic extracapsular extension</td>
<td>extensive extracapsular, seminal vesicles, lymph nodes</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Size</th>
<th>Insignificant</th>
<th>Minimal</th>
<th>Moderate</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.2 cm³</td>
<td>&lt; 0.2 cm³</td>
<td>0.2 - 0.5</td>
<td>&gt; 0.5 or caps penetration</td>
<td>&gt; 0.5</td>
</tr>
<tr>
<td>Gleason</td>
<td>&lt;7</td>
<td>&lt;7</td>
<td>&lt;7</td>
<td>&gt;7</td>
</tr>
<tr>
<td>Extent</td>
<td>confined</td>
<td>confined</td>
<td>capsular penetration</td>
<td>caps penetration, seminal vesicles, lymph nodes</td>
</tr>
</tbody>
</table>
Image Guided Focal Therapy for Prostate Cancer

• Localized prostate cancer is the new challenge of the PSA era
• Requires rethinking of diagnostic and treatment strategies
• What about focal therapy?
  – Can we identify tumor(s) within the prostate in order to treat ONLY the cancer?
Correlation of Magnetic Resonance Imaging Tumor Volume with Histopathology

Baris Turkbey,* Haresh Mani,* Omer Aras,* Ardeshir R. Rastinehad,* Vijay Shah,† Marcelino Bernardo,* Thomas Pohida,* Dagane Daar,* Compton Benjamin,* Yolanda L. McKinney,* W. Marston Linehan,* Bradford J. Wood,‡ Maria J. Merino, Peter L. Choyke and Peter A. Pinto§

From the Molecular Imaging Program (BT, OA, MB, DD, YLM, PLC), Laboratory of Pathology (HM, MJM) and Urologic Oncology Branch (ARR, CB, WML, PAP), National Cancer Institute, and Division of Computational Bioscience, Center for Information Technology (TP) and Center for Interventional Oncology, NCI and Radiology and Imaging Sciences, Clinical Center (BJW, PAP), National Institutes of Health, Bethesda, Imaging Physics, SAIC Frederick, Inc., NCI-Frederick, Frederick (MB), Maryland, and VirtualScopics, Rochester, New York (VS)

• Evaluated 135 patients at the NCI who had multi-parametric 3T endorectal coil prostate MRI followed by radical prostatectomy
• The index tumor volume was determined prospectively and independently by MRI and confirmed by histopathology
FOCAL ABLATION STRATEGIES

• Margin $\leq 3$mm around the edge of the lesion is an acceptable error for center of lesion delivered therapy

• Circumferential margin of treatment is 5mm around the lesion

• This allows a targeting error of 2-3mm to prove a positive hit rate of 90-95%

Hu et al. Medical Image Analysis 2012
Cornud et al. Journal of Urology 2014
Treatment Template
Energy Delivery

- High Intensity focused Ultrasound
- Cryotherapy
- Photodynamic Therapy
- Laser Interstitial Thermal Therapy
- Irreversible electroporation
- Radiation
- Nanoparticles
- Radiofrequency Ablation
- More to come
Energy Delivery

- Multiple focal therapies available
  - Commonly used: Cryotherapy, HIFU, laser ablation, and radiofrequency ablation
- Insufficient evidence to support one modality over another
- Best modality is the one the clinician is most experienced with
### Table 1: Summary of current focal therapy energy modalities (energy sources with >1 study available)

<table>
<thead>
<tr>
<th>Modality</th>
<th>Energy</th>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Continence (Pad-free rate)</th>
<th>Erectile dysfunction rate</th>
<th>Operative monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryotherapy</td>
<td>Cell membrane disruption</td>
<td>Transperineal</td>
<td>• Real-time monitoring&lt;br&gt;• Short inpatient stay</td>
<td>• Difficult with small prostates or anterior tumours&lt;br&gt;• High cost</td>
<td>89–100%</td>
<td>0–42%</td>
<td>• Ultrasonography&lt;br&gt;• MRI&lt;br&gt;• Thermosensors</td>
</tr>
<tr>
<td>HIFU</td>
<td>Thermal injury</td>
<td>Transrectal</td>
<td>• Noninvasive&lt;br&gt;• Short inpatient stay</td>
<td>• Difficult with large glands&lt;br&gt;• Rectal toxicity</td>
<td>85–100%</td>
<td>11–45%</td>
<td>• MRI&lt;br&gt;• Ultrasonography</td>
</tr>
<tr>
<td>Laser</td>
<td>Photothermal injury</td>
<td>Transperineal</td>
<td>• Real-time monitoring&lt;br&gt;• Short inpatient stay</td>
<td>• Limited experience&lt;br&gt;• Difficult in anterior tumours</td>
<td>NR*</td>
<td>0%*</td>
<td>MRI thermometry</td>
</tr>
<tr>
<td>Photodynamic therapy</td>
<td>Cytotoxic oxidative stress</td>
<td>Transperineal</td>
<td>Short inpatient stay</td>
<td>• Limited experience&lt;br&gt;• Photosensitizer toxicity&lt;br&gt;• High rate of residual disease</td>
<td>NR*</td>
<td>0%*</td>
<td>• MRI&lt;br&gt;• Ultrasonography</td>
</tr>
<tr>
<td>Irreversible electroproportion</td>
<td>Electropulse</td>
<td>Transperineal</td>
<td>Short inpatient stay and operative time</td>
<td>• Limited experience</td>
<td>100%</td>
<td>5–44%</td>
<td>TRUS</td>
</tr>
<tr>
<td>Brachytherapy</td>
<td>Radiotherapy</td>
<td>Brachy seed insertion</td>
<td>• Short inpatient stay&lt;br&gt;• Can alter dosing</td>
<td>• Limited experience&lt;br&gt;• Rectal toxicity&lt;br&gt;• High cost</td>
<td>NR*</td>
<td>NR*</td>
<td>NA</td>
</tr>
<tr>
<td>Radiofrequency ablation</td>
<td>DNA disruption</td>
<td>Transperineal</td>
<td>Short inpatient stay</td>
<td>• Limited experience&lt;br&gt;• No oncological data</td>
<td>NR*</td>
<td>NR*</td>
<td>Variable</td>
</tr>
</tbody>
</table>

HIFU, high-intensity focused ultrasound; NA, not applicable; NR, not reported; TRUS, transrectal ultrasonography. *Limited data available.
Focal Brachytherapy

• No long term data from large clinical trials
• Approx 5 trials listed as cancer.gov website
• More likely to follow as this will be a future direction of research by radiation oncology

• 318 men with cT1c, PSA < 15, Gleason ≤ 3 + 4 received MRI-guided brachytherapy in which only the PZ was targeted. PSA failure was defined as nadir + 2 with PSA velocity >0.75 ng/mL/yr.

• Median follow-up of 5.1 yrs 26 men failed. PSA failure-free survival at 5 and 8 years was 95.6% and 90.0% for low risk, and was 73.0% and 66.4% for intermediate risk.

J Clin Oncol. 2012 Feb 10;30(5_suppl)

- 17 men screened with mpMRI, 14 proceeded to TTMB, 5 received focal LDR-PB. Follow-up included PSA, mpMRI and TTMB.

<table>
<thead>
<tr>
<th>Patient</th>
<th>mpMRI</th>
<th>Highest PI-RADS</th>
<th>No. cores extracted</th>
<th>No. positive cores</th>
<th>Highest GS</th>
<th>Total PCa extent within cores (mm)</th>
<th>Highest GS from pre-enrollment TRUS biopsy</th>
<th>Eligible for focal LDR-PB?</th>
<th>Treatment*</th>
<th>Reason for ineligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.0</td>
<td>3</td>
<td>28</td>
<td>2</td>
<td>3 + 4</td>
<td>6.5</td>
<td>N</td>
<td>LDR-PB</td>
<td>Bilateral PCa</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>17.9</td>
<td>No lesion found</td>
<td>32</td>
<td>2</td>
<td>3 + 3</td>
<td>4</td>
<td>N</td>
<td>AS</td>
<td>Contradictory biopsy results</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>81.2</td>
<td>4</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3 + 3</td>
<td>Withdrawn</td>
<td>AS</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>26.5</td>
<td>2</td>
<td>24</td>
<td>2</td>
<td>3 + 3</td>
<td>5.2</td>
<td>Y</td>
<td>RP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>63.5</td>
<td>3</td>
<td>48</td>
<td>2</td>
<td>3 + 3</td>
<td>4</td>
<td>Y</td>
<td>Focal LDR-PB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>29.7</td>
<td>3</td>
<td>29</td>
<td>3</td>
<td>3 + 3</td>
<td>7.1</td>
<td>Y</td>
<td>Focal LDR-PB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>50.7</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3 + 3</td>
<td>Withdrawed</td>
<td>Status unknown</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>48.5</td>
<td>3</td>
<td>38</td>
<td>5</td>
<td>4 + 3</td>
<td>15</td>
<td>3 + 4</td>
<td>N</td>
<td>LDR-PB</td>
<td>Bilateral PCa</td>
</tr>
<tr>
<td>9</td>
<td>29.2</td>
<td>2</td>
<td>32</td>
<td>8</td>
<td>3 + 3</td>
<td>41.5</td>
<td>3 + 3</td>
<td>N</td>
<td>AS</td>
<td>Bilateral PCa</td>
</tr>
<tr>
<td>10</td>
<td>20.2</td>
<td>3</td>
<td>22</td>
<td>5</td>
<td>3 + 3</td>
<td>16</td>
<td>3 + 3</td>
<td>N</td>
<td>LDR-PB</td>
<td>Bilateral PCa</td>
</tr>
<tr>
<td>11</td>
<td>66.0</td>
<td>3</td>
<td>38</td>
<td>3</td>
<td>3 + 4</td>
<td>4</td>
<td>3 + 4</td>
<td>N</td>
<td>LDR-PB</td>
<td>Bilateral PCa</td>
</tr>
<tr>
<td>12</td>
<td>34.3</td>
<td>3</td>
<td>23</td>
<td>5</td>
<td>3 + 3</td>
<td>7</td>
<td>3 + 3</td>
<td>N</td>
<td>LDR-PB</td>
<td>Bilateral PCa</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient</th>
<th>mpMRI</th>
<th>Prostate vol. (cc)</th>
<th>Highest PI-RADS</th>
<th>No. cores extracted</th>
<th>No. positive cores</th>
<th>Highest GS</th>
<th>Total PCA extent within cores (mm)</th>
<th>Highest GS from pre-enrollment TRUS biopsy</th>
<th>Eligible for focal LDR-PB?</th>
<th>Treatment*</th>
<th>Reason for ineligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td></td>
<td>43.0</td>
<td>4</td>
<td>30</td>
<td>2</td>
<td>3 + 3</td>
<td>4</td>
<td>3 + 3</td>
<td>Y</td>
<td>Focal LDR-PB</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>19.1</td>
<td>5</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3 + 4</td>
<td>N</td>
<td>AS</td>
<td>Large PI-RADS 5/5 anterior lesion on mpMRI. TTMB not performed</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>22.5</td>
<td>4</td>
<td>22</td>
<td>3</td>
<td>3 + 4</td>
<td>6.5</td>
<td>3 + 4</td>
<td>Y</td>
<td>Focal LDR-PB</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>48.9</td>
<td>3</td>
<td>41</td>
<td>5</td>
<td>3 + 4</td>
<td>8.5</td>
<td>3 + 4</td>
<td>Y</td>
<td>AS</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>33.5</td>
<td>4</td>
<td>28</td>
<td>3</td>
<td>3 + 4</td>
<td>3</td>
<td>3 + 4</td>
<td>Y</td>
<td>Focal LDR-PB</td>
<td></td>
</tr>
</tbody>
</table>

- 17 men screened with mpMRI, 14 proceeded to TTMB, 5 received focal LDR-PB. Follow-up included PSA, mpMRI and TTMB.

- Of the 5 treated pts 3 had repeat mpMRI with no residual cancer seen and 2 have had repeat TTMB at 24 months with no residual cancer detected.

# TABLE 1. Characteristics of different focal therapy modalities

<table>
<thead>
<tr>
<th>Focal Therapy Modality</th>
<th>Mechanism of prostate cancer ablation</th>
</tr>
</thead>
</table>
| Cryotherapy                     | Argon-based probes are inserted to targeted prostate area via direct transperineal image-guided placement.\(^1\)  
                                  | Mechanism of action\(^2\)  
                                  | 1) Formation of ice crystals within cells leading to rupture of cell membranes, protein denaturation, and disruption of cell metabolism  
                                  | 2) Vascular coagulation leading to micro thrombi, tissue ischemia, and cell death  
                                  | 3) Induction of apoptosis                                                                 |
| High intensity focused ultrasound (HIFU) | Transrectal ultrasound transducer deposits focused high intensity energy to targeted prostate area.  
                                  | Mechanism of action\(^3\)  
                                  | 1) Conversion of ultrasound energy to heat by the tissue, leading to three different levels of heat-induced damages  
                                  | a) \(>43^\circ\text{C}\) — Hyperthermia: arrest of cell reproduction  
                                  | b) \(>56^\circ\text{C}\) — Coagulative necrosis: irreversible protein denaturation and cell death  
                                  | c) \(>100^\circ\text{C}\) — Vaporization of water in tissue leading to necrosis and charring  
<pre><code>                              | 2) Acoustic cavitation: high acoustic intensity causes tissue to vibrate and form microbubbles. Microbubbles oscillate and collapses violently, causing mechanical stress to tissue and disperse thermal energy that enhances tissue ablation. |
</code></pre>
<table>
<thead>
<tr>
<th>Focal Therapy Modalities</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Photodynamic therapy</strong></td>
<td>Oral or intravenous photosensitive agents are activated by laser light inserted through transperineal image-guided placement directed at targeted prostate area. <strong>Mechanism of action</strong>(^4) 1) Activated photosensitive agent transfers energy to ground-state oxygen, releasing reactive singlet oxygen species.  a) Singlet oxygen destroys tumor vasculature.  b) Induction of cell necrosis and apoptosis  c) Activation of acute inflammatory response and local migration of leukocytes</td>
<td></td>
</tr>
<tr>
<td><strong>Focal laser ablation (FLA)</strong></td>
<td>NdYAG or 830-nm to 980-nm diode lasers are inserted to targeted prostate area via transperineal image-guided approach. <strong>Mechanism of action</strong>(^5) 1) Mechanisms of heat-induced damages caused by laser therapy are similar to those described in HIFU therapy above.</td>
<td></td>
</tr>
</tbody>
</table>
# Focal therapy in prostate cancer: modalities, findings and future considerations

*Uri Lindner, John Trachtenberg and Nathan Lawrentschuk*

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Phase I trials of focal therapy in men with localized prostate cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of incontinence (%)</td>
<td>Potency maintained (%)</td>
</tr>
<tr>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>3.6</td>
<td>72</td>
</tr>
<tr>
<td>0</td>
<td>71</td>
</tr>
<tr>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>0</td>
<td>Not studied</td>
</tr>
<tr>
<td>0</td>
<td>No change</td>
</tr>
</tbody>
</table>

Duration of follow-up varied between studies, although was most often months (as opposed to years), illustrating the lack of sufficient long-term data regarding focal therapy. Abbreviations: BFR, biochemical-free recurrence; HIFU, High-Intensity focused ultrasound.
FOLLOW UP

• Long term oncologic data unavailable
• One year follow up targeted biopsy is recommended
  – Often used to determine efficacy
  – Residual Gleason 3+3 of ≤3mm is acceptable
  – Residual Gleason ≥3+4 disease represents failure of treatment
FOCAL THERAPY APPROACH

- Cryotherapy → Coagulative necrosis as a result of freezing and thawing cycles
- Focal laser ablation
- HIFU → Coagulative necrosis as a result of high temperature thermoablation
NIH FOCAL LASER ABLATION CLINICAL TRIAL

• Transmission of laser energy into the tumor tissue via optical fiber
• Coagulative necrosis as a result of thermoablation
• MRI guidance at 1.5T or 3T
• Transperineal approach - coaxial
• Brachytherapy grid system
• Endorectal coil
• Foley catheter
74-year-old man, PSA=7.33ng/dl, 2 prior negative TRUS guided bx

Gleason 3+4 (60% core involvement)
Pre-FLA
Pre-FLA (PSA=7.33ng/ml)

6 months post-FLA (PSA=2.43ng/ml)
12 months post-FLA (PSA=2.59ng/ml)/targeted bx neg

24 months post-FLA (PSA=5.58ng/ml)/targeted bx neg
58-year-old man, PSA=6.65ng/dl, 1 prior negative TRUS guided bx

Gleason 3+4 (50% core involvement)

TRUS guided hydrodissection of the rectum and nerve
1 day post-FLA

6 months post-FLA (4.49ng/ml)
12 months post-FLA (PSA=4.09) targeted bx neg

24 months post-FLA (PSA=4.7) targeted bx neg
Image Guided Photothermal Focal Therapy for Localized Prostate Cancer: Phase I Trial


• 12 patients
• Low risk disease
• 75% patients home same day
• 100% catheter removed by 24hours

• Adverse events:
  • G1 – perineal discomfort (4), hematuria (2), hemospermia (1), fatigue (1)
    - No high grade AEs

• No significant changes in IIEF or IPSS at 6 months

• 8 patients with no tumor at ablation site (2pts with contralateral G6)

• 4 patients (33% of cohort) with residual cancer

Lindner et al. J Urol 2009;182:1371-77
PHASE 1 TRIAL RESULTS

• University of Chicago
  – 9 cases: 8 Gleason 6, 1 Gleason 3+4
  – No major complications
  – Minor perineal injury in 1 case
  – Transient glans penis paresthesia in 1 case
  – IPSS and SHIM scores are stable
  – 6 months follow up / MRI and biopsy
  – Oncologic outcomes: 2/9 case residual cancer

Oto et al. Radiology 2013
PHASE 1 TRIAL RESULTS

• NIH
  – 15 cases: low-intermediate risk PCa
    • 7 cases Gleason 3+3
    • 8 cases Gleason 3+4
  – No major complications
  – Hematuria in 4 cases
  – 1 case of epididymitis
  – IPSS and SHIM scores are stable
  – 1 year follow-up / MRI and TRUS / MRI fusion biopsy
  – Oncologic outcomes: 3/15 case residual cancer

TRANSURETHRAL MR-GUIDED HIGH INTENSITY ULTRASOUND SYSTEM FOR FOCAL ABLATION OF PROSTATE CANCER

Nitin Yerram, Ari Partanen, Hari Trivedi, Dmitry Volkin, Jeffrey Nix, An Hoang, Baris Turkbey, Marcelino Bernardo, Matthew Dreher, Peter Choyke, Bradford Wood, Aradhana Venkatesan, Peter Pinto.

National Cancer Institute, National Institutes of Health
Bethesda, Maryland
BJU International Vol 112, Issue 4, pages 508–516, August 2013
Transurethral Applicator

- Axially rotating applicator under robotic control
- Eight colinear 0.5cm elements (f = 3 or 6 Mhz, max $P_{ac} = 4W$)
- Cooling via circulating degassed water
planning

Transducer localization

Burn 1-temperature map with dose overlay

Burn 2-temperature map with dose overlay

Post HIFU raw contrast enhanced MRI

HE stain of necrotic areas

Partanen BJUI 2014
ADVANTAGES

- Effective detection of target lesion
- Relatively efficient navigation
- Simultaneous thermometer of ablation and protection of critical adjacent structures
DISADVANTAGES

• Expensive procedure
  – MRI compatible equipment needed
  – Long MRI time block: 3-4 hours processing time
  – Urologist, interventional radiologist and diagnostic radiologist
  – Multicenter trials and oncologic follow up are necessary
CONCLUSIONS

• Role of focal therapy is evident for selected low and intermediate risk prostate cancer
• Prospective trials will provide morbidity and functional outcomes of each treatment modality
• Long term follow up data will be necessary for oncologic outcomes
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