MRI guided focal therapies

Jurgen Fütterer MD PhD

j.futterer@rad.umcn.nl
Department of Radiology
Radboud University Medical Center
Nijmegen, The Netherlands
Learning Objectives

• to show the potential MR image guided therapies

• to illustrate this from a clinical perspective
Background

• Clinical applications

- **Brain** tumors (difficult areas)
- **Bone** lesions
- Liver lesions
- Renal lesions
- **Prostate** cancer (focal therapy)
(Focal) treatment of prostate cancer:

- Whole gland vs focal/hemigland treatment

- To meet the requirements for focal treatment
  * diagnostic imaging (lesion)
  * high-quality imaging
  * assistance / guidance imaging
  * realtime monitoring
  * assess extent / totality
Pro

MRI:

• excellent functional soft-tissue contrast
• able to localize the tumor
• to target it with probes
• to monitor and control the intervention in real-time, to map tissue temperature
• no X-rays to acquire images
Con

MRI:

- Limited workspace (open vs closed bore)
- MR compatible equipment
- Expensive
Closed MRI

Gangi et al. Strasbourg
MR-guided ablation techniques

- MR-guided focused ultrasound (MRgFUS)
- Laser-induced thermal therapy (LITT)
- Cryosurgery (iceball)
- Radiofrequency ablation
Guidance

- MR scanner
- MR comp devi
- Needle guider
- Biopsy needle / fiber
- Difficulties in MRgLA:
  - Needle-guide positioning
  - Slice positioning
• Time consuming
• Displacement
Department of Medical Physics in Radiology, Deutsches Krebsforschungszentrum (DKFZ), Heidelberg, Germany
15 Watt, 980 nm, 2:00 minute exposure

400 μm core fiber with 10 mm diffusing tip
in 16 Ga (5 Fr) cooling catheter
Volumetric heating + Rapid energy deposition → Sharp transition zone between dead and viable tissue

Transition zone in RF and Cryo can be 5-10 mm

980nm Laser transition zone is less than 1 mm
Introduction

• Cryoablation:
  • Freezing of tissue
Introduction

- US-guided Cryoablation
  → High complication rate:

- Incontinence 4.3 – 72%
- Erectile dysfunction 57 – 77.8%
- Rectal fistula 0 – 3.4%

Materials and Methods

Materials

- MR scanner
- MR Cryo equipment
- MR Cryo needles
- Flexible arm and grid
- Urethral warmer
- Rectal warmer
**Materials and Methods**

- Patient preparation
  - Antibiotics prophylaxis
  - Enema
- General anesthesia
- Insert urethral warmer
- Patient positioning
  - Head first supine
  - Lithotomy position
- Insert rectal warmer
Materials and Methods

- Sterile draping
Materials and Methods

- Tumor localisation and needle path planning
Materials and Methods

- Testing cryoneedles
Materials and Methods

• Needle insertion
Materials and Methods

• Needle insertion
Materials and Methods

- Insert $2^{nd}/3^{rd}/...$ needle
- Check needle positions
- Start freezing
Materials and Methods

- Real time image iceball growth
Materials and Methods

- Freezing ~ 10 minutes
- Thawing
  - Passive ~ 2 minutes
  - Active ~ 3 – 5 minutes
- Repeat Freeze-thaw cycle
- End procedure
Results

- Procedure and setup time → Decreasing
Results

• **Follow-up Patient 1:**

  **Before**
  
  **PSA 2.7 ng/mL**

  **3 months**
  
  **PSA 2.2 ng/mL**
DWI with b values 0, 50, 600

ADC map showing restricted diffusion

c. J. Feller, Palm Springs USA
Tumor destroyed while leaving surrounding structures untouched

No general anesthetic

Most patients: Return home within hours, with
• No pain
• No Foley catheter
• No complications
Conclusion:

- MRgInterventions are possible with the present techniques.

- These ‘novel’ procedures require validation in prospective clinical trials with more patients and longer follow-up and must be compared to active surveillance and radical therapies in randomized controlled trials.
Thank you for your attention

Barentsz, Bomers, Bosboom, de Lange, Scheenen, Schouten, Yakar

Hulsbergen, van Lin, van Oort, Witjes, Sedelaar