Focal Treatment of Prostate Cancer with Therapeutic Ultrasound

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Scope of the Disease

- Prostate cancer is a prevalent condition
  - 180,000 new cases per year
  - Second leading cause of cancer death in men
- Current diagnostic methods lead to over diagnosis or are highly invasive
- The standard for treatment is whole gland resection or irradiation
  - Very invasive
  - Treatment co-morbidities occur in 42% of cases

Diagnosis with MRI

- Magnetic resonance imaging (MRI) is non-invasive
  - MRI is highly sensitive to variations in tissue properties
- Tumor features can be distinguished with different types of MRI
  - T2 MRIs indicate presence of prostate cancer
  - Diffusion MRIs can stage prostate cancer
  - Dynamic Contrast MRIs assess tumor vascularityization

Image Guidance for Therapeutic Ultrasound with MRI and Diagnostic Ultrasound

Transurethral Thermal Ablation

- Ultrasound transducer applied directly in urethra
  - No surgical incision
  - Prostate tissue heating from ultrasound energy to kill cancer
  - Heating pattern can be visualized with MRI
  - Can steer ultrasound beam and assess treatment progress
  - Not efficacious for large or highly vascularized cancer

Transcutaneous Mechanical Ablation

- Shock wave ultrasound pulses are applied across skin
  - The shockwaves form bubbles in the tissue
  - Strong bubble oscillations ablate tumor cells and also produce ultrasound emissions
  - Passive cavitation imaging is under development to map the location and energy of the cavitation ultrasound emissions

Assessment of Therapeutic Efficacy with MRI

Contrast enhanced image of thermal ablation after transurethral ultrasound

T1 weighted image of chicken breast ablated with mechanical ultrasound (dark region)

References


Acknowledgements

Funding provided by the Focused Ultrasound Foundation (31R1), NIH (5R25CA132822-04), Cancer Research Foundation, University of Chicago Comprehensive Cancer Center, and Northwestern Medicine.