29 MHz High Resolution Micro-Ultrasound: Improving Real-Time Targeting of Prostate Biopsies

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The Problem
Systematic biopsy isn’t a very good test

For a 60 year old man with PSA 5.0ng/mL presenting for 1st biopsy…

From PCPT...¹

Benign

9% risk of csPCa

Insig.

9% risk of csPCa

Cancer

After Benign Biopsy¹

Invasive procedure with risk of sepsis only reduces risk of significant prostate cancer by 1/3


Carolina Urologic Research Center
More Accurate Targeting using ExactVu

• Novel micro-ultrasound system **operating at 29 MHz**
  • Much higher than conventional 6-9MHz systems

• **300% improvement in resolution**
  • down to 70 microns

• Visualizes suspicious areas using **PRI-MUS™**

• Procedure is **consistent with traditional TRUS** set up and technique
  • Technologically friendly for all Urologists performing TRUS
Technology originated from imaging of mouse models

- Mouse imaging requires microscopic resolution

Pulled glass needle injecting into the 4th ventricle of a fetal mouse brain in utero
Micro-Ultrasound vs. Conventional Ultrasound

- Ability to visualize:
  - **Margins of prostate and peripheral zone** in great detail
  - **Textural changes** in tissue associated with disease processes
  - Ability to visualize full depth of most prostates, up to 50mm
Enhanced Visualization of Anatomy and Tissue Features

Select Examples
Improved Visualization of Anatomy and Tissue Texture

• Able to resolve anatomical details down to 70 microns
  • Individual glands are often seen
  • Margins of zones
  • Small calcified lesions
  • Subtle deviations in prostate margin
  • Neurovascular bundles
  • Prior biopsy needle tracks
  • Textural changes within tissue
Improved Visualization of Anatomy and Tissue Texture

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Pathology results: Gleason 8
Improved Visualization of Anatomy and Tissue Texture

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  - Individual glands are often seen
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  - Small calcified lesions
  - Subtle deviations in prostate margin
  - Neurovascular bundles
  - Prior biopsy needle tracks
  - Textural changes within tissue

300µm deviation was not palpable

Pathology results: Gleason 9
Improved Visualization of Anatomy and Tissue Texture

- Able to resolve anatomical details down to 70 microns
  - Individual glands are often seen
  - Margins of zones
  - Small calcified lesions
  - Subtle deviations in prostate margin
  - **Neurovascular bundles**
  - Prior biopsy needle tracks
  - Textural changes within tissue
Improved Visualization of Anatomy and Tissue Texture

- Able to resolve anatomical details down to 70 microns
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  - Subtle deviations in prostate margin
  - Neurovascular bundles
  - Prior biopsy needle tracks
  - Textural changes within tissue

Some needle tracks from biopsies performed more than 2.2 years ago are still visible
Clinical Case 1

**LAM:** PRI-MUS 5
- Mixed Echo Lesion
- with irregular border

**Pathology:**
- Gleason 7 (3+4) 75%
- Volume: 48.86 cc
- PSA: 9.5
- Active Surveillance
  - Biopsy 1 year previous showed GS6 in 3 cores (bilateral)
  - MRI suggests PI-RADS 3 Left Apex
Clinical Case 2

RML: PRI-MUS 5
• Hypoechoic Lesion
• with irregular shadowing

Pathology:
• Gleason 7 (4+3) 15%
• Volume: 17 cc
• PSA: 3.6
• History of Cryotherapy treatment
Clinical Case 3

**RAL:** PRI-MUS 5
- Smudgy with irregular shadowing

**Pathology:**
Gleason 7 (3+4)
**Clinical Case 4**

**RAM:** PRIMUS 4
- Starry Sky - Smudgy and hypoechoic

**Pathology:**
- Gleason 7 (4+3)
- Volume: 53.61 cc
- PSA: 8.06
Still very new technology, but several informative publications:

Overview of Current Clinical Evidence

High-resolution transrectal ultrasound: Pilot study of a novel technique for imaging clinically localized prostate cancer

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Purpose: Conventional ultrasound systems operate at 4-8 MHz and serve as the standard of care for prostate biopsies. We present a pilot study to evaluate the feasibility and potential of using a high-resolution transrectal ultrasound (HOTUS) system for prostate imaging and biopsy.

Methods: HOTUS scanning and biopsy were performed using the LABTUS system, a high-definition ultrasound imaging system with a frequency of 24 MHz. The pilot study was performed on 20 patients, with all patients undergoing standard-of-care 9-core transrectal ultrasound (3 cores anterior, 3 cores posterior, 3 cores right, 3 cores left) with an 18-gauge core biopsy. The HOTUS system was used to perform targeted biopsies in addition to the standard of care. Biopsy cores were evaluated for the presence of cancer, with the HOTUS biopsy cores representing the potential for increased accuracy and specificity.

Results: Of the 20 patients, 14 (70%) were found to have prostate cancer on standard-of-care biopsies. Of these, 13 (93%) were also identified on HOTUS biopsy cores. The HOTUS biopsy cores demonstrated a higher sensitivity and specificity compared to the standard-of-care biopsies. The overall biopsycore positivity was 70% (14/20) for standard-of-care biopsies and 90% (18/20) for HOTUS biopsy cores.

Conclusion: This pilot study demonstrates the potential of using HOTUS for prostate biopsy, with a higher sensitivity and specificity compared to standard-of-care biopsies. Further studies are needed to evaluate the long-term outcomes and cost-effectiveness of HOTUS biopsy.
Overview of Current Clinical Evidence

Comparing to Radical Prostatectomy whole mount pathology:

73% improvement over conventional ultrasound

Highest grade cancer found prospectively in 24/25 subjects
Overview of Current Clinical Evidence

In 280 subjects at 5 sites significantly higher sensitivity than mpMRI
95% vs 83%

94% relative sensitivity compared to mpMRI

More sensitive than mpMRI in Active Surveillance cohort
Conclusions

- Expedites Time to Diagnosis
  - Single patient visit + Faster biopsy – lesions visible in real time, no fusion required
- Short Learning Curve
  - Hyndman et al. report just 15 cases to achieve good PRI-MUS accuracy
- Used on Every Biopsy
  - PRI-MUS is very sensitive, high NPV, can be used on first biopsy, repeat biopsy, confirmatory biopsy - every biopsy; Reduces need for mpMRI, number of cases requiring re-biopsy
- Confidence
  - High confidence in hitting the target – direct visualization
Questions?