A novel approach to prostate biopsy using MRI fused cone-beam CT

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BACKGROUND

- Prostate cancer is the most common non-cutaneous malignancy in Canadian men[1].
- Transrectal ultrasound (TRUS) is widely used for prostate biopsy[2].
- Cone-beam CT (CBCT) fused to MRI images allows for direct coaxial needle placement into an MRI target using real time 3D fluroscopy[3].
- This is a new technique with no prior reports using this method.
- Initial evidence of 20 patients revealed no immediate or 30-day complications and upstaged patient's Gleason scores compared to previous TRUS-guided biopsies[3].

HYPOTHESIS

- We hypothesize that CBCT-guided biopsy will have an adequate safety profile while accurately detecting prostate cancer.

METHODS

Single urban academic center database

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Retrospective chart review of 139 patients and 161 procedures ← Inclusion Criteria:
- Those with an MRI lesion graded as ≥ PI-RADS 3.
- Clinically suspected of prostate cancer by oncologic urologist.
- Received MRI fused CBCT-guided prostate biopsy transgluteally at Kingston General Hospital.

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Data collection:

- Patient characteristics, demographics, previous biopsies, immediate and 30-day complications, biopsy results

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Statistical analysis:

Descriptive statistics
- Mean ± standard deviation reported for continuous variables (e.g., age, PSA level).
- Frequencies and percentages reported for categorical variables (e.g., Gleason score, PI-RADS score, previous biopsy results, complication types, severity).

Complication Profile
- Quantify the types of adverse events and their rates.

Spearman's Rank Correlation Analysis
- Calculated between PI-RADS and Gleason scores to evaluate whether higher imaging-based scores correlated with higher-grade prostate cancer.

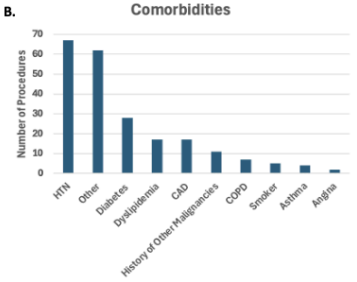
Figure 1. Overview of study methodology.

RESULTS

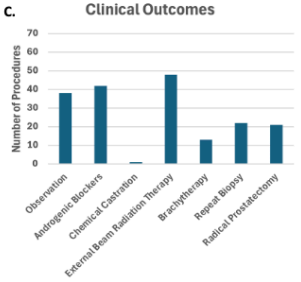
A.

Age (Mean ± SD) (n=161)	PSA (Mean ± SD) (n=149)	Gleason Score (Mode) (n=161)	PI-RADS Score (Mode) (n=161)
68.0 ± 7.1	10.7 ± 7.2	7	5

B.



C.



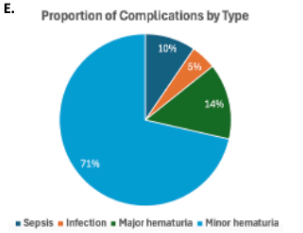
D.

Number of Complications by Type as a Percentage of Total Procedures

Complication Types	Complication Rates (N,%)
Minor Hematuria	15 (9.3%)
Major Hematuria	3 (1.9%)
Sepsis	2 (1.2%)
Infection	1 (0.6%)

*Minor hematuria – hematuria that resolved after the first void
*Major hematuria – hematuria requiring closer observation or admission

E.

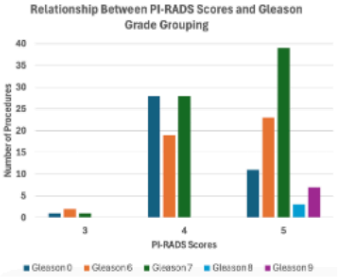


F.

Number of Procedures for Each Gleason Score Within PI-RADS Score Groups

PI-RADS Score	Total Gleason Score (N)				
	0	6	7	8	9
3	1	2	1	0	0
4	28	19	28	0	0
5	11	23	39	3	7

G.



Figures 3A-G. A&B) Patient characteristics. **C)** Clinical outcomes following biopsy. **D & E)** Nineteen patients (11.8%) with 21 procedures had complications, leading to an overall serious complication rate of 1.9% (3/161), excluding hematuria. **F & G)** A statistically significant positive correlation between PI-RADS and Gleason scores ($\rho = 0.3$ $p < 0.05$). HTN = hypertension, CAD = coronary artery disease, COPD = chronic obstructive pulmonary disease.

DISCUSSION

- A 1.9% rate of serious complications is consistent with prior studies[6,7].
- Hematuria occurred in 11.2% of cases which is lower than reported rates of 14.4–84%[7] with TRUS, and no patients required transfusions.
- Our correlation of 0.3 between PI-RADS and Gleason scores aligns with existing literature, with one study reporting a correlation coefficient of ~0.3 following TRUS-guided prostate biopsies[8].
- Limitations include small sample size, single-center design, and reliance on one interventional radiologist. Patients presenting to other medical centers may not be accounted for, however, significant complications were likely captured in follow-up clinic records. We also recognize the lack of widespread MRI access may limit broader implementation.
- Overall, MRI-fused CBCT-guided biopsy demonstrates a favorable safety profile and diagnostic accuracy comparable to TRUS-guided techniques.

IMPLICATIONS

- This study offers preliminary evidence supporting MRI-fused CBCT-guided prostate biopsy as a safe, accurate, and potentially more precise alternative for prostate cancer detection, with advantages in patient safety and comfort.

KEY REFERENCES

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CONFLICTS OF INTEREST

- We declare no conflict of interest.