2022

Observed Concordance of Prostate Lesions on MRI with MRI/ Ultrasound Fusion Biopsy Results

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Overview

Introduction

Objectives

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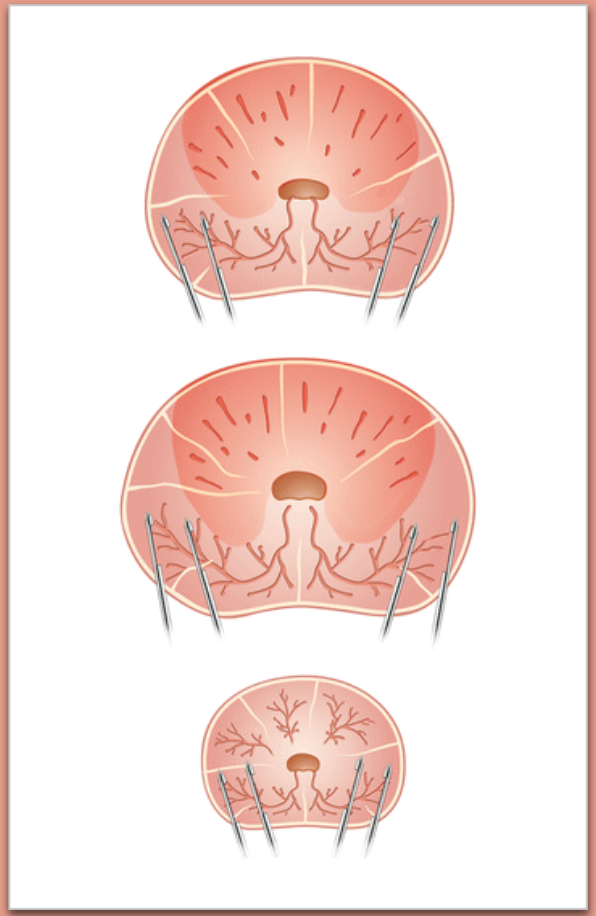
Discussion

Introduction

- Prostate cancer is the most common non-cutaneous cancer and the second leading cause of cancer death in men
- Most present asymptomatically after an elevated prostate-specific antigen (PSA) or abnormal digital rectal exam (DRE)
- Diagnosis of prostate cancer is based on histologic tissue with an assigned Gleason score obtained through a core needle biopsy
- Traditionally, the gold standard for diagnosis is a transrectal ultrasonography guided biopsy of the prostate



Transrectal US-guided biopsy

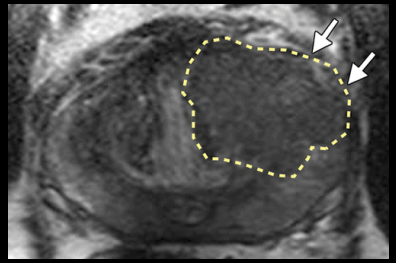
- Results in 10-12 core samples guided towards different anatomic locations
  - Largely centered on the peripheral zone of the prostate resulting in under sampling of the midline and anterior gland
- Allows accurate pretreatment disease risk stratification in only about 16% of patients[2]
  - False negative rate is 47%
  - Under diagnoses 38% of tumors
  - Will detect incidental cancer of little or no clinical relevance

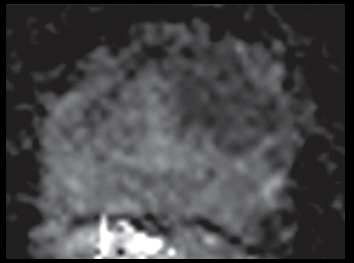
Newer Targeted Biopsy Methods for the Prostate

- Cognitive Fusion Biopsy
- Direct MRI Guided Biopsy
- MRI/US Fusion Biopsy

MRI/Ultrasound Fusion Biopsy: The Multiparametric MRI

- Multiparametric MRI combines anatomic detail imaging with physiologic information to allow for accurate detection of prostate lesions
- Lesions will be given a specific PI-RADS score based on their imaging characteristics by the radiologist
- Suspicious lesions based on their PI-RADS score can be contoured on the MRI with a specific software (our Urology institution use Artemis and bkFusion)





PI-RADS

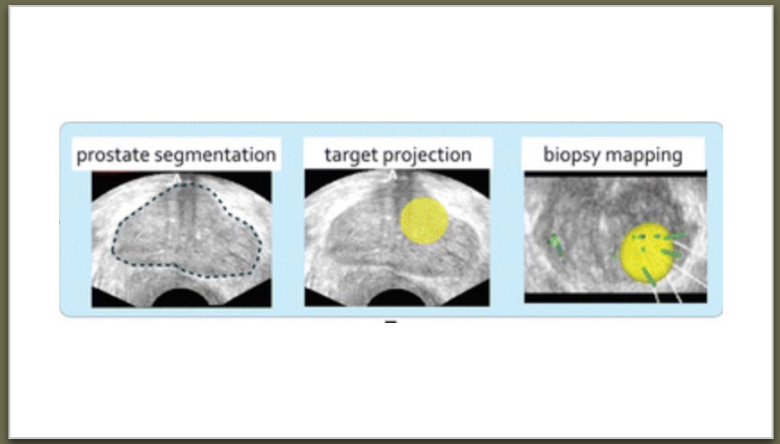
PI-RADS 1 = Very low (clinically significant cancer highly unlikely)

PI-RADS 2 = Low (clinically significant cancer unlikely)

PI-RADS 3 = Intermediate (clinically significant cancer equivocal)

PI-RADS 4 = High (clinically significant cancer likely)

PI-RADS 5 = Very high (clinically significant cancer highly likely)



MRI/Ultrasound Fusion Biopsy: The Biopsy

- Software can merge the contoured MRI lesions with a real time conventional ultrasound machine
- Suspicious areas seen at MRI will be overlaid on the transrectal ultrasound screen while performing the biopsy allowing the Urologist to perform a targeted approach

MRI/Ultrasound Fusion Biopsy

- Early reports show that the fusion biopsy technique may detect up to 30% more high risk cancers and 17% fewer low risk cancers

- However, the success rate of MRI/Ultrasound fusion biopsies are not consistent across institutions

- Reasons for inconsistency may include:
  - Steep learning curve for reporting and interpretation of prostate MRI
  - Operator experience performing the biopsy
  - Type of software platform used for fusion guidance

Objectives of Our Study

Primary End Point

Determine if our radiology-pathology institutional concordance for MRI-ultrasound fusion biopsies of the prostate matches the literature for predicting clinically significant prostate cancer.

Objectives of Our Study

Secondary End Points

- Compare specific patient characteristics including PSA level and PSA density for lesions with clinically significant cancer to those without
- Compare the utility of the magnetic strength of the MRI in detecting clinically significant MRI lesions

Study Design

-Data was collected retrospectively for 218 patients who underwent contoured prostate MRIs, dating from January 1, 2019 to December 31, 2019 at our institution which includes three different facility locations

- Determined if an MRI/US fusion biopsy was performed for each specific lesion identified on the MRI

-Compared the lesions and whole gland score to the biopsy result to assess for concordance of clinically significant prostate cancer (Clinically significant score defined by a Gleason score >7)

- Reviewed existing literature and compared our concordance rate to published data

Data Collection and Exclusion Criteria

- Data elements extracted for each patient included location of MRI, age of patient, PSA level before biopsy, prostate volume, prostate density, strength of MRI scanner, # of lesions identified on MRI, location of lesion, size of lesion, if the biopsy was positive, size of lesion on biopsy, percent positive of biopsy and Gleason Score

- Exclusion criteria included no identifiable lesion on MRI, biopsy not performed, and biopsy site inconsistent with MRI site

Image Analysis: Images were interpreted by 9 different radiologists at our institution

Biopsy: All biopsies were performed by experienced urologists who were not blinded to PIRADS score

Histopathology: Reviewed by a pathologist at the corresponding institution

RESULTS

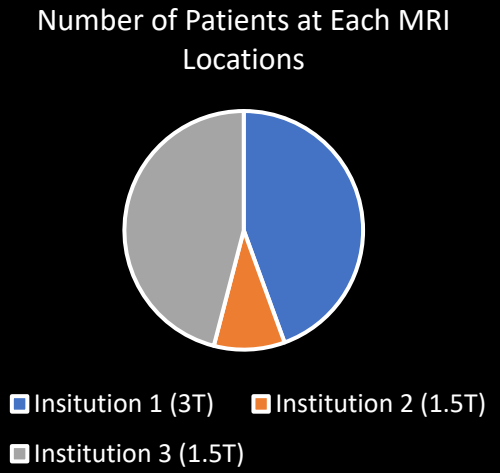
218 prostate mpMRIs were reviewed

21 patients were excluded

197 patients had MRI lesions with corresponding biopsy results

Total of 232 Prostate Lesions

197 Whole Gland Scores Reported



Patient Characteristics

Characteristic	Range	Average
Age (years)	47-85	67
PSA Level Before Biopsy (ng/mL)	0.8-118.7	9.91
Prostate Volume (mL)	16-177	56.7
Prostate Density (ng/ml^2)	0.02 – 1.88	0.21
Number of lesions on MRI	1-3	1.3

Number of Clinically Significant Prostate Cancers based on Whole Gland PI-RADS Score

Whole Gland PI-RADS Score Based on MRI	Number of Patients assigned per Score	Number of Clinically Significant Cancer Detected	Percent Positive
PI-RADS 3	75	18	24%
PI-RADS 4	88	51	58%
PI-RADS 5	34	25	74%

Number of Clinically Significant Prostate Cancers Detected per Lesion's PI-RADS score

Whole Gland PI-RADS Score Based on MRI	Number of Patients assigned per Score	Number of Clinically Significant Cancer Detected	Percent Positive
PI-RADS 3	105	12	11%
PI-RADS 4	98	44	45%
PI-RADS 5	29	17	59%

Our Institutional Concordance Rate Compared to Existing Literature for Expected Positive Predictive Value Based on Whole Gland PI-RADS Score

	Our Institution	Study 1	Study 2
PI-RADS 3	24%	12%	13%
	https://pubs.rsna.org/doi/10.1148/radiol.2020190646		
PI-RADS 4	58%	48%	40%
PI-RADS 5	74%	72%	69%

Study 1: Barkovich, E. J., Shankar, P. R., & Westphalen, A. C. (2019). A systematic review of the existing Prostate imaging reporting and data system version 2 (PI-RADSV2) literature and subset meta-analysis of PI-RADSV2 categories stratified by Gleason scores. *American Journal of Roentgenology*, *212*(4), 847–854. https://doi.org/10.2214/ajr.18.20571

Study 2: Mazzone, E., Stabile, A., Pellegrino, F., Basile, G., Cignoli, D., Cirulli, G. O., Sorce, G., Barletta, F., Scuderi, S., Bravi, C. A., Cucchiara, V., Fossati, N., Gandaglia, G., Montorsi, F., & Briganti, A. (2021). Positive predictive value of prostate imaging reporting and Data System version 2 for the detection of clinically significant prostate cancer: A systematic review and meta-analysis. *European Urology Oncology*, *4*(5), 697–713. https://doi.org/10.1016/j.euo.2020.12.004

PSA Values in Cancer Lesions Compared with Non-Cancerous Lesions

Summarized PSA Data	
Clinically Significant Cancer	Average PSA **(10.39)**
Non-Clinically Significant Cancer	Average PSA **(9.99)**

- Total of **232** lesions analyzed

Comparison of PSA Density in Clinically Significant Cancerous Lesions to Non-Clinically Significant

- PSA densities ranged from **0.02-1.55**

Summarized PSA Density Data	
Clinically Significant Cancer	Average PSA Density **(0.27)**
Non-Clinically Significant Cancer	Average PSA Density **(0.17)**

Comparison of the Number Clinically Significant Prostate Cancer Lesions with Different Strength MRIs

Summarized Data Comparing 1.5T and 3T MRI Identified Lesions (Including PI-RADS 3, 4 and 5 Lesions)

	Number of Clinically Significant lesions	Number of total lesions	Percent of clinically significant lesions
1.5T	46	135	**34%**
3T	27	97	**27%**

Discussion

- Our institutional concordance rate for whole gland MRI lesions and MRI/Fusion biopsies is similar to existing literature
- Patient's with clinically significant prostate cancer are more likely to have a higher PSA level and density compared to those who do not
- Using a 3T magnetic strength MRI does not improve the positive predictive value for patients undergoing MRI/Fusion biopsy

Discussion

- Overall, our results show our radiologists, urologists and pathologists are performing up to the standard of care for MRI/US fusion biopsies
- MRI magnet strength did not significantly influence cancer detection rates for patients undergoing MRI/Fusion biopsy
- Limitations included small sample size, the pathology results did not always specify the exact location of targeted biopsy, and studies we compared our data to were meta-analysis that used a wider variety of biopsy methods and MRI scanner

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