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The Role of Multiparametric Magnetic Resonance Imaging/Ultrasound Fusion Biopsy in Active Surveillance

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Article info

Abstract

Background: Multiparametric magnetic resonance imaging (mpMRI)/ultrasound fusion biopsy (targeted biopsy or TB) may improve detection of high-grade cancers when compared to systematic biopsy (SB).
Objective: To assess TB in active surveillance (AS).
Design, setting, and participants: We retrospectively evaluated SB (12-core sector) and TB among 103 AS men undergoing surveillance biopsy, 54 men undergoing confirmatory biopsy (CB), and 73 men referred for diagnostic biopsy (DB; comparison group). Regions of interest (ROIs) on mpMRI were assigned a PI-RADS score and targeted if the score was ≥ 3.
Outcome measurements and statistical analysis: Detection of Gleason score (GS) ≥ 7 by TB and SB was the outcome of interest, except in a multivariable model, for which any cancer was the outcome.
Results and limitations: GS ≥ 7 was detected by either biopsy method in 25 men (24.3%) in the AS group, 12 men (22.2%) in the CB group, and 55 men (75.3%) in the DB group. GS ≥ 7 was found in 24.3% by SB + TB versus 20.4% by SB in the AS group ($p = 0.13$); in 22.2% by SB + TB versus 16.7% by SB in the CB group ($p = 0.25$); and in 75.3% by SB + TB versus 58.9% by SB in the DB group ($p = 0.002$). The sensitivity for GS ≥ 7 detection was lower for TB than for SB ($p = 0.006$) in the AS cohort (relative sensitivity ratio 0.33, 95% confidence interval 0.16–0.71). Higher PI-RADS score (4 vs 3, odds ratio [OR] 2.00, $p = 0.04$; 5 vs 3, OR 4.74, $p = 0.02$), lower MRI-estimated prostate volume (OR 1.20 per 10-cm^3 lower volume, $p = 0.01$), larger ROI (OR 1.04 per mm, $p = 0.02$), and right-sided ROI (OR 2.27, $p = 0.01$) were associated with finding cancer on TB. A potential limitation is that not all men who presented for biopsy underwent TB and the urologist was not blinded to MRI results before SB.
Conclusions: Owing to the low relative sensitivity of mpMRI for detection of GS ≥ 7 disease, SB still needs to be performed for men on AS.
Patient summary: This study suggests that image-guided prostate biopsy alone may not be informative for men enrolled in an active surveillance program for prostate cancer.

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1. Introduction

Prostate-specific antigen (PSA) testing is associated with higher prevalence of favorable-risk prostate cancer [1]. Active surveillance (AS) can reduce overtreatment of men with favorable disease. Men diagnosed with favorable cancers may harbor higher-grade cancers and miss an opportunity for cure when on AS [2].

A 12-core transrectal ultrasound (TRUS)-guided prostate biopsy (systematic biopsy, SB) is used to identify and monitor patients on AS [3]. It has been estimated that SB samples less than 0.05% of the prostate [4] and has a false-negative rate exceeding 20% [5]. Thus, SB can lead to misclassification of risk in men eligible for AS.

Advances in multiparametric magnetic resonance imaging (mpMRI) allow high-quality visualization of the prostate and improved identification of prostate cancer [6,7], especially in the anterior gland [8,9]. Studies show that mpMRI/TRUS fusion biopsy (targeted biopsy, TB) is associated with greater detection of high-risk cancer and lower detection of low-risk cancer when compared to SB [7,10]. The role of TB in AS is not clear [11]. Thus, we sought to assess the use of TB among AS candidates.

2. Patients and methods

2.1. Study cohort selection

From April 2014 to August 2015 (study period), 230 men (study cohort) underwent TB and SB in the same setting for AS monitoring,

confirmation before AS, or diagnosis (Table 1). We included men who underwent a diagnostic biopsy as a comparison group.

2.2. AS cohort

From January 1995 to August 2015, 1511 men with favorable-risk disease chose AS (Table 1), as previously reported [2]. Monitoring consisted of semi-annual PSA measurement, a clinical examination, and annual biopsy in most men.

During the study period, 365 men had a surveillance biopsy, of whom 256 (70.1%) underwent mpMRI at a median of 8 mo (interquartile range [IQR] 2–15) before biopsy. Of these 256, 129 men (50.4%) had a region of interest (ROI) on mpMRI with a Prostate Imaging Reporting and Data System (PI-RADS) score $\geq$ 3, and 127 (49.6%) had no ROI (PI-RADS <3). Of the 129 men, 103 (79.8%) underwent TB and SB, 23 did not undergo TB, and three had TB at another institution. Comparison between men who did and did not undergo TB revealed no difference in ROI lesion size (p = 0.17) or PI-RADS score (p = 0.39). The 103 men with TB and SB constituted the AS cohort. The median follow-up time and number of previous biopsies was 5 yr (range 2–17) and 3 (IQR 2–6), respectively. The 127 men without an ROI on mpMRI (PI-RADS <3) underwent SB and were included in the analysis for determination of cancer detection rates.

2.3. Confirmatory biopsy cohort

Men with favorable-risk cancer underwent a confirmatory biopsy (CB) within 1 yr of diagnosis [2]. The CB cohort comprised 54 men who underwent TB and SB after a diagnosis of favorable-risk disease, of whom 47 (87%) had their initial diagnostic biopsy at another institution. An additional two men who had Gleason score (GS) 3 + 4 on a diagnostic biopsy and had a CB were not included.

Table 1 – Study group characteristics

Variable	Study group		Comparison group	p value		
	AS cohort[a]	CB cohort	DB cohort	AS vs CB	AS vs DB	CB vs DB
Patients (n)	103	54	73			
Median age at biopsy, yr, (IQR)	70 (66–74)	66 (64–71)	65 (62–71)	0.002	0.0004	0.6
Median PSA at biopsy, ng/ml (IQR)	5.4 (3.2–7.4)	5.2 (3.7–6.5)	7.3 (5.0–10.8)	0.37	0.0005	0.008
Median PSA density at biopsy, ng/ml/ml (IQR)	0.08 (0.06–0.13)	0.12 (0.07–0.16)	0.16 (0.12–0.26)	0.02	<0.0001	<0.0001
Median mpMRI-estimated prostate volume, ml (IQR)	55 (40–80)	42 (32–55)	40 (29–60)	0.003	0.0004	0.83
Median lesion size, mm (IQR)	8 (7–13)	9 (7–14)	12 (9–16.5)	0.17	<0.0001	0.03
Targeted biopsy cores						
Median number obtained, n (IQR)	3 (3–6)	3 (3–6)	4 (3–6)			
Median number positive for cancer, n (IQR)	0 (0–1)	0 (0–2)	2 (1–3)	0.16	<0.0001	0.0005
Standard biopsy cores						
Median number obtained, n (IQR)	12 (12–12)	12 (12–12)	12 (12–12)			
Median number positive for cancer, n (IQR)	1 (0–2)	1 (0–3)	3 (1–5)	0.23	<0.0001	0.001
Lesions, n (%)						
PI-RADS score 3	89 (58)	41 (48)	31 (28)	<0.0001		
PI-RADS score 4	56 (36)	34 (40)	45 (40)			
PI-RADS score 5	8 (6)	10 (12)	36 (32)			
Race, n (%)						
African-American	5 (5)	5 (9)	6 (8)	0.12		
Caucasian	91 (90)	47 (87)	56 (78)			
Others	7 (5)	2 (4)	11 (14)			

AS = active surveillance; CB = confirmatory biopsy; DB = diagnostic biopsy; PSA = prostate-specific antigen; IQR = interquartile range; CI = confidence interval; mpMRI = multiparametric magnetic resonance imaging; PI-RADS = Prostate Imaging Reporting and Data System.
[a] Eligibility for AS was limited to men with very low-risk disease (stage T1c, PSA density $\leq$0.15 ng/ml, Gleason score $\leq$6, $\leq$2 positive biopsy cores, and $\leq$50% cancer involvement per core) or low-risk disease (stage $\leq$T2a, PSA $\leq$10 ng/ml, and Gleason score $\leq$6).