EUROPEAN UROLOGY ONCOLOGY XXX (2018) XXX–XXX

available at www.sciencedirect.com
journal homepage: euoncology.europeanurology.com

European Association of Urology

The Role of Systematic and Targeted Biopsies in Light of Overlap on Magnetic Resonance Imaging Ultrasound Fusion Biopsy

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Article info

Article history:
Accepted March 20, 2018

Associate Editor:
Alberto Briganti

Keywords:
Prostate cancer
Magnetic resonance imaging
Fusion biopsy

Abstract

Background: The value of a systematic biopsy in men with magnetic resonance imaging (MRI)–visible regions of interest (ROIs) undergoing fusion biopsy (FBx) is unclear.

Objective: To determine the utility of concurrent systematic biopsy with ROI biopsy in detecting clinically significant prostate cancer (CSPC).

Design, setting, and participants: Retrospective study of 240 men who underwent FBx with the Artemis platform. Software captured biopsy distribution maps. Biopsy distribution maps were reviewed to determine which systematic cores overlapped with the ROI. Histopathology for overlapping systematic cores were reclassified as ROI cores.

Outcome measurements and statistical analysis: Detection of CSPC on true systematic biopsy was the outcome measured. Multivariable logistic regression was used to determine if age, prostate-specific antigen, prostate volume, prior biopsy status, and Prostate Imaging-Reporting and Data System categorization were associated with CSPC detection and Gleason grade upgrading on systematic biopsy.

Results and limitations: The median number of systematic cores overlapping with ROIs was 2 (interquartile range 1–2). After accounting for overlap, 14 men (5.8%) had a higher Gleason grade on systematic biopsy. Of these, seven (2.9%) were upgraded from benign and three (1.3%) from clinically insignificant cancer on systematic biopsy. In adjusted analysis, prior negative biopsy (odds ratio [OR] 0.46, 95% confidence interval [CI] 0.21–0.99; $p = 0.046$) was associated with absence of CSPC on systematic biopsy, while age (OR 1.11, 95% CI 1.02–1.21; $p = 0.015$) was associated with upgrading. Limitations include the retrospective data and the use of a single biopsy platform.

Conclusions: Detection of CSPC on systematic biopsy that might influence clinical decision-making is uncommon in men undergoing FBx. In men with a prior negative biopsy, a target-only FBx strategy could be considered because of the low yield on systematic biopsy.

Patient summary: We found that random prostate sampling adds little diagnostic value in men who are undergoing a targeted biopsy of suspicious lesions found on imaging, especially for men who have had a prior negative biopsy.

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https://doi.org/10.1016/j.euo.2018.03.009
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Please cite this article in press as: Patel N, et al. The Role of Systematic and Targeted Biopsies in Light of Overlap on Magnetic Resonance Imaging Ultrasound Fusion Biopsy. Eur Urol Oncol (2018), https://doi.org/10.1016/j.euo.2018.03.009

1. Introduction

The use of magnetic resonance-ultrasound fusion biopsy (FBx) in men with elevated serum prostate-specific antigen (PSA) is becoming increasingly widespread in routine clinical practice [1]. Prostate magnetic resonance imaging (MRI) allows for identification of suspicious regions of interests (ROIs) that may have been missed with systematic biopsies and, more importantly, direct sampling of ROIs via FBx [2]. In this context, it has been shown that FBx improves the detection of clinically significant prostate cancer (CSPC) [3,4].

Although ROI biopsies often improve the detection of significant cancer, up to 16% of men with negative multiparametric MRI may harbor CSPC [4]. Thus, the majority of men currently undergoing FBx will have both targeted biopsies of MRI-identified ROIs and a standard 12-core systematic biopsy. However, the CSPC yield for targeted biopsy alone versus systematic biopsy after accounting for overlapping of systematic biopsy cores with ROIs has not been well studied. In addition, there is no clear consensus on whether a systematic biopsy should be repeated during FBx in men who have already had a negative transrectal ultrasound-guided systematic biopsy. This is clinically relevant as the risks of antimicrobial resistance and urosepsis increase with the number of cores sampled [5].

The Artemis FBx platform (Eigen, Grass Valley, CA, USA) digitally captures systematic and targeted biopsy cores, and it can be discerned whether a systematic biopsy sampled an area within an ROI. In this retrospective study of men undergoing FBx, we investigated the systematic biopsy yield for the detection of CSPC after accounting for systematic cores that overlapped with the ROI, which were reclassified as ROI biopsy cores. Accounting for this classification bias may reconcile some of the differences in study outcomes when evaluating the relative benefit of targeted versus systematic biopsy.

2. Patients and methods

2.1. Study population

Our study was approved by the Weill Cornell Medicine Center institutional review board. We retrospectively reviewed all men who underwent MRI fusion biopsy performed by a single surgeon (J.C.H.) between November 2015 and August 2017 at our institution ($n = 263$). Men on active surveillance, those with MRI results from another institution, and those with an ROI with a Prostate Imaging-Reporting and Data System (PI-RADS) v.2.0 score of <3 were excluded, resulting in a final cohort of 240 men for analysis.

2.2. MRI FBx

All men underwent contrast-enhanced multiparametric MRI using a 3-T magnet without an endorectal coil. Studies were performed with T1 and three-plane small field-of-view T2-weighted imaging, dynamic contrast-enhanced imaging, and diffusion-weighted imaging with an apparent diffusion coefficient map and computed high *b*-value images conforming to PI-RADS v.2. Suspicious target lesions were identified and subsequently mapped for FBx by an experienced uroradiologist (D.J.M.). Biopsies were performed using the Artemis platform. All biopsies were performed in the clinic setting under local anesthesia. After targeted biopsy of the ROI(s), a systematic biopsy was performed with the Artemis-generated template, which geometrically spaces the 12 systematic cores throughout the prostate. Frequently, the ROI encompasses one or more of the systematic biopsy locations, such that these systematic biopsies result in additional samples from the ROI. Therefore, although systematic cores are labeled as distinctly different from targeted biopsies of the ROI, they are in fact biopsies of the ROI. This may also occur with cognitively directed systematic biopsies; however, the inability to capture and record the needle trajectory of the systematic cores performed cognitively relative to the ROI prevents appropriate reclassification of the systematic biopsies as actual ROI biopsies.

2.3. Study design

We retrospectively reviewed the recorded the 3-dimensional needle trajectories relative to the ROI in both the transverse and sagittal planes. Systematic cores that overlapped with the ROI were reclassified as a targeted biopsy (Fig. 1). Histopathology for each individual core was reviewed and the location of CSPC was reclassified based on overlap. The primary outcome was detection of CSPC in the systematic biopsy (Gleason score ≥ 7). Descriptive statistics were reported for patient demographics and clinical characteristics such as age, PSA, prostate volume, prior biopsy status, and PI-RADS categorization. Multivariable logistic regression was performed to evaluate if age, PSA, prostate volume, prior biopsy status, and PI-RADS categorization were associated with the detection of CSPC on systematic biopsy and upgrading by systematic biopsy over targeted biopsy. Age, PSA, and prostate volume were modeled as continuous variables a priori. Two-sided p values are reported, with statistical significance evaluated at the level of 0.05. Stata/SE v.13.1 (Stata Corp., College Station, TX, USA) was used for statistical analysis.

3. Results

Demographic and clinical characteristics are presented in Table 1. Men diagnosed with CSPC were older (70.4 vs

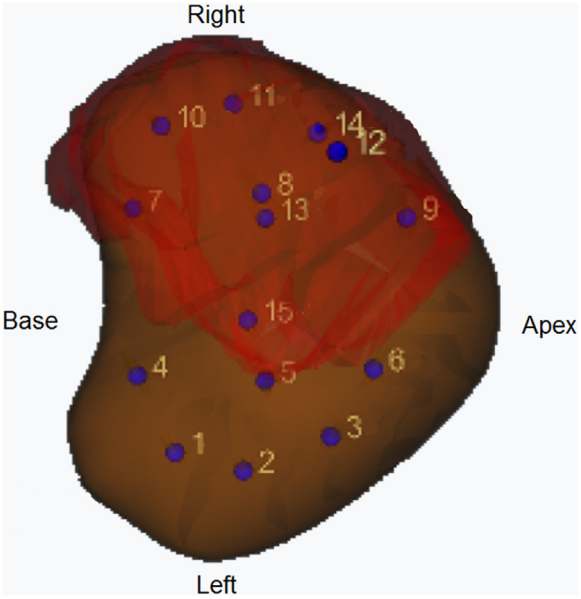

Fig. 1 – Demonstration of significant overlap of all systematic biopsies from the right side (cores 7–12) with the ROI with a Prostate Imaging-Reporting and Data System categorization of 5. Cores 13–15 represent the targeted ROI cores. In this case, systematic cores 7–12 resampled the ROI and "overlapped". ROI = region of interest.

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