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Analysis of prostate cancer localization toward improved diagnostic accuracy of transperineal prostate biopsy

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Purpose: Delineating the precise localization of prostate cancer is important in improving the diagnostic accuracy of prostate biopsy.
Methods: In Juntendo University Nerima Hospital, initial 12-core or repeat 16-core biopsies were performed using a transrectal ultrasound guided transperineal prostate biopsy method. We step-sectioned prostates from radical prostatectomy specimens at 5-mm intervals from the urethra to the urinary bladder and designated five regions: the (1) Apex, (2) Apex-Mid, (3) Mid, (4) Mid-Base, and (5) Base. We then mapped prostate cancer localization on eight zones around the urethra for each of those regions.
Results: Prostate cancer was detected in 93 cases of 121 cases (76.9%) in the Apex, in 115 cases (95.0%) in the Apex-Mid, in 101 cases (83.5%) in the Mid, in 71 cases (58.7%) in the Mid-Base, and in 23 cases (19.0%) in the Base. In 99.2% of all cases, prostate cancers were detected from the Apex to Mid regions. For this reason, transperineal prostate biopsies have routinely been prioritized in the Apex, Apex-Mid, and Mid regions, while the Base region of the prostate was considered to be of lesser importance. Our analyses of prostate cancer localization revealed a higher rate of cancer in the posterior portion of the Apex, antero-medial and postero-medial portion of the Apex-Mid and antero-medial and postero-lateral portion of the Mid. The transperineal prostate biopsies in our institute performed had a sensitivity of 70.9%, a specificity of 96.6%, a positive predictive value (PPV) of 92.2% and a negative predictive value (NPV) of 85.5%.
Conclusions: The concordance of prostate cancer between prostatectomy specimens and biopsies is comparatively favorable. According to our study, the diagnostic accuracy of transperineal prostate biopsy can be improved in our institute by including the anterior portion of the Apex-Mid and Mid regions in the 12-core biopsy or 16-core biopsy, such that a 4-core biopsy of the anterior portion is included.

Keywords: Needle biopsy, Prostatectomy, Prostate neoplasms

INTRODUCTION

Systematic transrectal biopsy was first introduced by Hodge et al. [1] in 1989, with numerous modifications and adjustments to the procedure subsequently suggested [2,3]. Recently, 10- to 12-core extended prostate biopsies have superseded the sextant biopsy, with greater than 12-core reportedly failing to show any significant increase in cancer detection rate [4,5]. McNeal et al. [6] reported that 68% of all prostate cancers which they detected was localized in the peripheral zone (PZ), 24% in the transition zone (TZ), and 8% in the central zone. The localization of prostate cancer is known to be different in Japanese patients than in those from Western countries, with a greater tendency for detection in the Apex region in Japan [7-10]. We undertook the current study to improve the diagnostic efficiency of transperineal prostate bi-

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opsies performed in Juntendo University Nerima Hospital by analyzing specimens from radical prostatectomies in order to determine the precise localization of prostate cancer.

MATERIALS AND METHODS

1. Materials

We analyzed radical prostatectomy specimens of 121 patients from Juntendo University Nerima Hospital in the period from April 2007 to December 2012. All patients underwent open radical prostatectomy and had preoperative clinical staging of cT2 or under, while none underwent pretreatment such as transurethral resection of the prostate or neoadjuvant hormonal therapy. The patients ranged from 53 to 78 years old, with an average and median age of 67.6 and 68 years, respectively. PSA level at the time of diagnosis ranged from 1.2–32.5 ng/mL, with an average of 8.9 ng/mL and a median level of 7.9 ng/mL. The preoperative clinical stage was cT1 in 37 patients and cT2 in 84 patients. Gleason score (GS) of prostate biopsies were as follows: GS≤6, 41 cases (35.7%); GS=7, 46 cases (40.0%); GS≥8, 28 cases (24.3%). GS of prostatectomies were as follows: GS≤6, 31 cases (27.0%); GS=7, 62 cases (53.9%); GS≥8, 22 cases (19.1%). The pathological stages were as follows: pT2a, 27 cases (22.3%); pT2b, 1 case (0.8%); pT2c, 58 cases (48.0%); pT3a, 28 cases (23.1%); and pT3b, 7 cases (5.8%).

2. Methods

The specimens from radical prostatectomy were fixed in formalin, after which sections were step-sectioned at 5-mm intervals. As shown in Fig. 1, the prostate was divided into five regions from the Apex of the urethra to the Base of the urinary bladder, centered around the Mid region, with designations as follows: A, Apex; A–M, Apex–Mid; M, Mid; M–B, Mid–Base; and B, Base. Each region was then divided into eight zones around the urethra, with each region further designated as: E, antero–lateral; F, antero–medial; G, postero–lateral; and H, postero–medial. The transperineal prostate biopsies were performed utilizing ultrasonography equipment (Toshiba Medical Systems Co., Otawara, Japan), using a 7.0-MHz biplane transrectal probe (PVL-715RT) and a BARD MAGNUM (C.R. Bard Inc., Covington, GA, USA) biopsy needle with 22-mm penetration length. The probe was equipped with an adapter (UAGL-001AHA Toshiba Medical Systems Co.) for the biopsy needle running parallel to the probe. In Japanese patients with prostate cancer, the cancer has been reported to localize at a higher frequency in the Apex as compared to patients from Western countries [8,9]. Therefore, we inserted the biopsy needle transperineally, penetrating the prostate

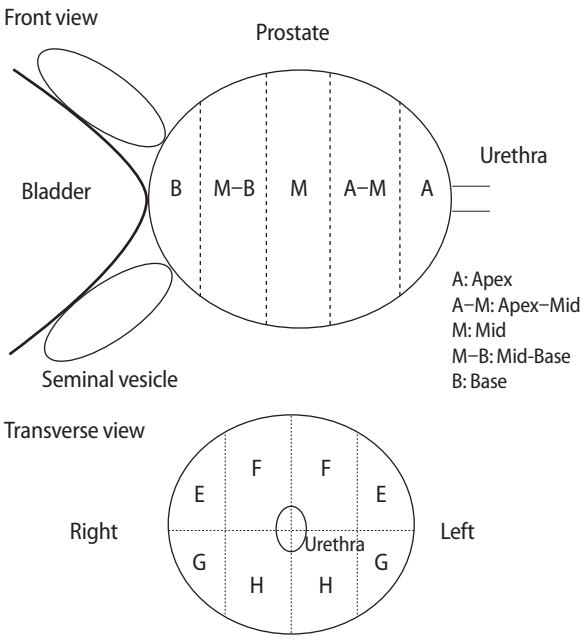

Fig. 1. Five regions from the Apex to the Base and eight zones around the urethra with each region. E, antero–lateral; F, antero–medial; G, postero–lateral; and H, postero–medial.

capsule, and performing biopsies in the Apex, Apex–Mid, and Mid regions (Fig. 2). Fig. 3 shows the methods of 12-core transperineal biopsies in our institute. Eight-core biopsy samples are taken from the PZ in ①–④, ⑦–⑩ and 4-core biopsy samples are taken from TZ in ⑤, ⑥, ⑪, and ⑫. Repeat biopsies included a supplementary 4 cores in the anterior portion (⑬–⑯) for a total of 16 cores. Although the size and shape of each prostate gland differs from one patient to another, a three-dimensional (transverse, lateral, and front) view of a transperineal prostate biopsy suggests that it is difficult to get samples from the far-lateral region of the Apex in PZ (① and ⑦) and the samples of ① and ② are taken from the Apex-Mid, Mid, and Mid-Base regions. Samples of ②, ③, ⑤, ⑧, ⑨, and ⑪ are taken from a portion of the Apex to the Mid-Base regions, while those of ④, ⑥, ⑩, and ⑫ are taken from the Apex to the Mid regions. Samples of the anterior portion including ⑬, ⑭, ⑮, and ⑯ are taken from the Apex to the Mid regions, with slightly upward inclination of the ultrasound probe and biopsy needle to avoid penetrating the pubic bones. For this reason, we conclude that when the prostate is enlarged, we would be unable to get biopsy specimens from the Base region in our institute. Fig. 4 shows the mapping of cancer locations and biopsy sites in each patient. A total 1,348 cores from biopsies from 110 patients were mapped onto each region and the concordance of prostate cancer in specimens obtained from prostatectomy and biopsy were used in the calculation of sensitivity, specificity, PPV, and NPV.