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Optimizing prostate biopsy for repeat transrectal prostate biopsies patients*

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Abstract ***Objective:*** Diagnosis of patients with negative prostate biopsy and persistent suspicion of prostate cancer remains a serious problem. In this study, we investigated the application of optimizing prostate biopsy for patients who need repeat prostate biopsy. ***Methods:*** In this prospective, non-randomized phase-I clinical trial, the prostate cancer detection rate of initial detection scheme was compared with optimizing prostate biopsy scheme. The number of punctures of initial detection scheme was the same as that of optimizing prostate biopsy scheme. The puncture direction of optimizing prostate biopsy was a 45° angle to the sagittal plane from front, middle, and back. The two cores from each lateral lobe were horizontally inwardly inclined 45°. ***Results:*** A total of 45 patients with initial negative biopsy for cancer were received the optimizing prostate biopsy scheme. The cancer detection rate was 17.8% (8/45), and prostate intraepithelial neoplasm (PIN) was 6.7% (3/45). The patients receiving repeat transrectal prostate biopsies were pathologically diagnosed as lower Gleason grade prostate cancers. ***Conclusion:*** The cancer detection rate of repeat biopsy prostate cancer is lower than that of initial biopsy. Our study showed that the optimizing prostate biopsy is important to improve the detection rate of repeat transrectal prostate biopsies patients.

Key words biopsy; prostate cancer; detection rate

Since introduction by Hodge *et al* [1], random, systematic, ultrasound-guided transrectal needle biopsy of prostate has significantly improved the diagnosis and treatment of prostate cancer. The strategies for biopsies remain controversial, especially repeated biopsy. With the widespread application of extended prostate biopsy protocols, the false negative rate remains substantial and early PCa detection remains limited [2–3]. Borboroglu *et al* [4] demonstrated that cancer detection rates approaching a third when extended biopsy schemes with up to 45 cores were used, even following multiple negative biopsies. For these patients, what can we do? Continue to extend prostate biopsy or further remove the entire prostate? Extended prostate biopsy greatly increased the pain and discomfort. The pain also increased with the number of biopsy specimens. Removal of the entire prostate to obtain pathological specimens will induce trauma and sexual dysfunction, and it was not suitable for patients with benign prosthetic hyperplasia. In order to resolve this problem, we investigated the application of optimizing prostate biopsy for patients who need repeat prostate biopsy.

Materials and methods

A prospective, randomized study was conducted from January 2009 to May 2013. Forty-five patients undergoing repeat prostate biopsy were selected in the study. Indication for biopsy was an increased PSA of 4 ng/dL or greater in all patients. All patients were administered cefaclor capsules (0.25 g) and metronidazole tablets (400 mg) twice a day from 3 days before procedure to 3 days afterwards. Then patients were in the left lateral decubitus position and administered local anesthesia with 1% tetracaine hydrochloride jelly using a spinal needle under ultrasound guidance and in rectum before biopsy.

Schematic diagram of the initial biopsy was showed in Fig. 1. Schematic diagram of the optimizing prostate biopsy for the patient who need repeat prostate biopsy was described in Fig. 2.

For the initial biopsy, the area of biopsy was calculated as πr^2, where r is needle radius. However, the area of optimizing biopsy was calculated by Pythagorean theorem,

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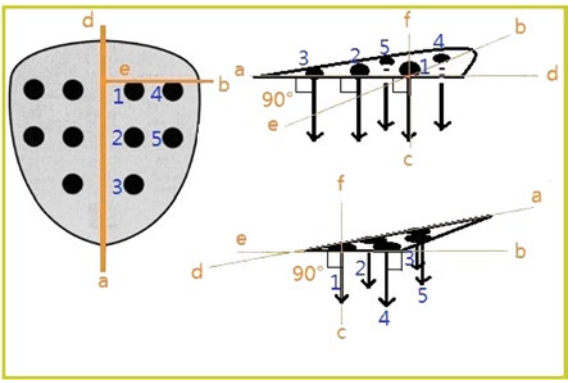

Fig. 1 Schematic diagram of the initial biopsy. Distribution of the number of biopsy on the prostate surface was on the left picture. From the right two pictures, we found that the direction of needle was parallel to the cf, but was perpendicular to the ad and eb

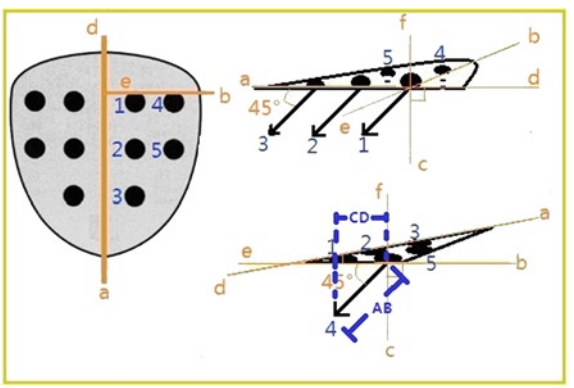

Fig. 2 Schematic diagram of the optimizing prostate biopsy. The picture on the left is the distribution of the number of biopsy on the prostate surface, which the same as the initial biopsy. Upper right picture shows that the directions of needle 1–3 with ad and cf are formed 45°, but the flat with the needle is perpendicular to the eb. Bottom right picture shows the direction of needle 4 with ad and cf are formed 45° in the flat of eb and cf

the hypotenuse of isosceles right triangle was the length of biopsy tissue, and the one right angle was the biopsy area we want.

The biopsy specimens were separately labeled and reviewed by one pathologist. Adequate biopsy samples were diagnosed as positive for PCa, high grade prostatic intraepithelial neoplasia (HG-PIN), or benign prosthetic hyperplasia. Biopsy cores positive for PCa had the Gleason score (GS).

The area of initial and optimizing biopsy were analyzed with SPSS 16.0. $P < 0.05$ was considered as statistically significant.

Results

A total of 45 patients with initial negative biopsy underwent repeat biopsies received the optimizing prostate biopsy scheme. The mean age of the patients was 67.4 ± 5.0 years. The mean PSA was 7.7 ± 2.7 ng/mL, while the mean GS was 3.1 ± 1.1. The cancer detection rate was 17.8% (8/45), prostate intraepithelial neoplasm (PIN) was 6.7% (3/45), and benign prosthetic hyperplasia was 75.6 (34/45). We got 17 positive cores on the sagittal and 6 positive cores on the lateral margin from 8 patients with PCa, the detection rate was 6.3% and 3.3%, respectively (Table 1).

Table 1 Prostate cancer detection with different biopsy locations

Biopsy location	Cancer detection rate (%)
Sagittal	6.3 (17/270)
Lateral margin	3.3 (6/180)
Overall	5.1 (23/450)

Discussion

Advances in prostate cancer (PCa) screening via transrectal ultrasound (TRUS) guided needle biopsies have led to a progressive increase in the number of prostate biopsy cores. In 2011, approximately one million biopsy procedures were performed in the US, from which 240 890 were diagnosed with PCa [5]. With a rising biopsy population and a low positive biopsy rate, the number of patients need repeated biopsies for exhibiting suspicious clinical signs has increased every year. What can we do? To repeat biopsy? But how do we know when to repeat biopsy? To increase the number core or optimize biopsy?

Single-session sextant biopsy might miss at least 20%–30% of detectable prostate cancer [6], Gore *et al* [7] suggested a 10-core biopsy strategy, and this protocol has improved the cancer detection rate by 25.5% . De la Taille A [8] *et al* reported that the cancer detection rate of a 21-core biopsy strategy was only 37%, and suggested that when the core is greater than 21-core, the cancer detection rate do not rise with the number of core biopsies. Thus, repeated biopsies are necessary when indicated. However, many patients might be overlooked with the repeated biopsy. Roehl *et al* [9] reported that cancer detection rates were 34% on the first TRUS biopsy, 19% on the second biopsy, 8% on the third biopsy, and 7% on the fourth biopsy. Durkan *et al* [10] reported that 31% (15 of 48) of the prostate cancers diagnosed in their patients was from specimens taken during second- or third-session sextant biopsy. Novara *et al* [11] reported that 143 patients with initial negative biopsy underwent a repeated biopsy with 24-core, and the cancer detection rate only 28%. So, for patients with need repeated biopsies, increasing the number of core biopsies does not mean increasing the positive rate.

We analyzed the substance to increase the number of core biopsies and found that the surface area of the prostate tissues increased with the number of core biopsies.

So, we considered to get more surface area of the tissue instead of increasing the number of core biopsies. With this interesting question, we designed a program optimized prostate biopsy in Fig. 2. For those patients who need repeat prostate biopsy, we took the same number of core biopsies from different directions.

Fig. 1 showed that the puncture directions were perpendicular to the ab, and the surface area of the biopsy prostate tissue was the same as the puncture needle size. From Fig. 2, we find that the directions of needle 1–3 with ad and cf are formed 45°. In the flat of eb and cf, the direction of needle 4 with ad and cf is formed 45°. According to Pythagorean theorem, we can know that CD is equal to (1/2) AB. So, if the prostate tissue (AB) that we got fixed length of 2.2 cm, the length of the surface area of the prostate tissue is equal to (1/2) AB. That is, we expand the range puncture by changing the puncturing direction. In our study, a total of 45 patients with initial negative biopsy for cancer underwent repeat biopsies received the optimizing prostate biopsy scheme. The number of punctures of initial detection scheme was the same as that of optimizing prostate biopsy scheme. The cancer detection rate was 17.8% (8/45), PIN was 6.7% (3/45), and benign prosthetic hyperplasia was 75.6 (34/45).

In our study, we suggested that the detection rate of prostate cancer might increased by 17.8% if the optimizing prostate biopsy scheme was performed first. The optimizing prostate biopsy can not only improve the detection rate of patients undergoing repeat transrectal prostate biopsies, but also increase the cancer detection rate in the initial puncture in some extent.

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