Diagnostic Yield and Complications Using a 20 Gauge Prostate Biopsy Needle versus a Standard 18 Gauge Needle: A Randomized Controlled Study

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Purpose: To compare and evaluate whether a 20 gauge (20G) biopsy needle maintains a similar detection rate as that of the commonly used 18G needle for transrectal ultrasound-guided prostate biopsy (TRUSPB) aimed at assessing prostate cancer (PCa) and decreasing pain and complications.

Materials and Methods: A total of 122 cases with indications of PCa were randomly allocated into two groups for this randomized controlled study. TRUSPB was performed randomly using either an 18G or 20G needle for core biopsies (62 cases with 18G and 60 cases with 20G). Detection rate, pain, and complications were assessed after the procedure.

Results: The cancer detection rate in the 18G group (40.3%) did not differ from that in the 20G group (35.0%). However, the number of patients with pain was significantly lower in 20G group ($P < .05$). The number of patients with self-limiting hematuria decreased in both groups after the biopsy procedure (18G: 38 cases; 20G: 16 cases; $P < .0001$). Hematochezia occurred in 11 cases (9 cases [14.5%] in the 18G group; 2 cases [3.4%] in the 20G group). The number of patients with infection, dysuria, and urinary retention tended to be lower in 20G group.

Conclusion: Use of a 20G needle for TRUSPB yielded a comparable cancer detection rate to that of an 18G needle and led to less local injury, pain, and complications. A larger and more sensitive study is needed to verify our results.

Keywords: prostatic neoplasms; diagnosis; biopsy; large-core needle; humans; ultrasonography; interventional; image-guided biopsy.

INTRODUCTION

Prostate cancer (PCa), particularly locally advanced/castration-resistant PCa, is one of the most common, life-threatening, malignant diseases in elderly men.[1] Transrectal ultrasound-guided prostate biopsy (TRUSPB) and the Gleason Score (GS) are the primary approaches for diagnosing PCa early. There is a correlation between the number of biopsy specimens and the detection rate.[2,3] Therefore, many factors, such as the number of samples and the size of the needle groove, affect the PCa detection rate. Many factors that increase the PCa detection rate and decrease the complications of TRUSPB have been researched, and the studies indicate that the results of the initial prostate biopsy should be used rather than taking more cores, which would increase the complication rate.[4] Current evidence indicates that an initial saturation biopsy scheme is more efficient than an extended scheme for detecting PCa, particularly in men with lower serum levels of prostate specific antigen (PSA), higher prostate volume (PV), or lower PSA density, without increasing complications and the amount of insignificant cancer.[5] Bjurlin and colleagues[6,7] suggested that 12-core biopsies ensure the highest detection rate, avoid duplicate sampling, and also provide an adequate diagnosis or differential diagnosis of prostate tissue. However, it is unknown whether the size of the biopsy sample affects the detection rate and grading accuracy. Prostate biopsies are usually performed with an 18 gauge (G) needle because a sufficient amount of tissue can be acquired; however, the sizes of TRUSPB biopsy needles have not been standardized.[8,9] Cicione and colleagues[10] compared 16G and 18G needles, and reported that needle size did not affect the concordance between biopsy and pathological GS.

In the present study, we evaluated whether a smaller

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Table 1. Clinical characteristics of study patients.

Variables	18G (n = 62)	20G (n = 60)	T Value	*P* Value
Age (year)	69.27 ± 10.62	68.03 ± 8.55	0.710	.258
PSA (ng/mL)				
Mean (SD)	55.42 ± 188.86	29.60 ± 82.87	0.972	.069
Median (range)	20.6 (0.713-78.26)	22.3 (2.755-366.61)		
PV (mL)	51.65 ± 34.65	52.42 ± 27.47	0.136	.173
DRE positive rate, %	40.5	38.9	0.223	.824

Abbreviations: PSA, prostate specific antigen; PV, prostate volume; DRE, digital rectal examination.

(20G) needle could achieve similar detection rates, pain scores, and complications compared to the standard 18G needle. A prospective, single-blinded, and randomized controlled study was conducted to compare the outcomes of patients biopsied using 18G or 20G needles to detect PCa.

MATERIALS AND METHODS

Study Subjects

This randomized controlled study was approved by the Ethics Committee of Beijing Hospital, China. Patients with suspicious PCa were referred exclusively to our hospital's outpatient clinical department of urology. The indications for TRUSPB were from the 2014 Chinese Guidelines of Urology: PSA > 4 ng/mL,[2] presence of a prostatic nodule on digital rectal examination (DRE) with a particular PSA level, and an imaging abnormality on ultrasound, computed tomography scan, or magnetic resonance imaging with a particular PSA level. All eligible patients gave informed consent. In all, 12 patients were excluded from the study for various reasons, and 122 who were suspected to have PCa were randomly assigned into two groups. The randomization was performed using the closed-envelope selection method, and the envelopes were kept in the operating room before the procedures. Sixty-two patients were assigned to group 1 (18G needles), and sixty patients were assigned to group 2 (20G needles). A flow diagram for the study is displayed in **Figure 1**. Age, PSA level, PV, and DRE-positive rates were not different between the two groups (**Table 1**). All eligible patients underwent a preoperative coagulation test to exclude those with coagulation abnormalities and other related diseases. A feasible TRUSPB procedure was performed only for patients who had stopped taking aspirin at least 1 week before the operation and had stopped clopidogrel (Plavix) at least 2 weeks preoperatively.

Procedures

After routine preoperative preparation, the patient was placed on the left hip, with knees and hips flexed 90°. A DRE was performed and the perianal skin and rectum were disinfected with iodine. Lidocaine gel was placed in the rectum. A medical ultrasound probe was covered with a condom, and the prostate biopsies were taken as systematic 12-core biopsies and an extra one or two core needle biopsy specimens were added during the TRUS-guided biopsy if any abnormal sites were detected by ultrasound. The 12 cores were evenly distributed

Table 2. Prostate cancer detection rate in the groups.

Variables	18G (n = 62)		20G (n = 60)		T Value	*P* Value
	BPH	PCa	BPH	PCa		
PSA						
< 4 ng/mL	9 (75.0)	3 (25.0)	11 (91.7)	1 (8.3)	1.076	.294
4.1-10 ng/mL	14 (66.7)	7 (33.3)	18 (72.0)	7 (28.0)	0.384	.703
10.1-20 ng/mL	12 (66.7)	6 (33.3)	10 (71.4)	4 (28.6)	0.280	.782
> 20 ng/mL	2 (18.2)	9 (81.8)	0 (0)	9 (100)	1.342	.198
Total	37 (59.7)	25 (40.3)	39 (65.0)	21 (35.0)	0.602	.548
Gleason score						
6		17 (68)		14 (66.6)	0.273	.604
≥ 7		8 (32)		7 (33.3)	0.043	.835

Abbreviations: PSA, prostate specific antigen; BPH, benign prostate hyperplasia; PCa, prostate cancer.
Data are presented as numbers (%).

Table 3. Evaluation of pain using facial expressions and the Wong–Baker Facial Expression Scale.

Marks	18G (n = 62)	20G (n = 60)	χ^2 Value	*P* Value
0-4	49	58	8.793	.003
5-7	9	2	4.887	.027
8-10	4	0	4.002	.045

around four vertical planes: right lateral, right medial, left medial, and left lateral. Three biopsy cores from each plane were located at the apex, middle, and base of the prostate, respectively.[11,12] The prostate tissue specimens were fixed in 10% formalin and labeled with the biopsy site. One experienced pathologist reviewed all histological specimens and determined the GS scores. A pain and bleeding questionnaire[13] was administered single-blindly to patients 20 min after TRUSPB. A DRE was performed, the rectal biopsy site was pressed for 5 min, and iodine gauze was packed into the rectal puncture points. The patients were requested to remove the gauze 4–6 h after the biopsy. All patients received prophylactic antibiotic (levofloxacin) according to the American Urological Association Best practice policy.[14] Further symptomatic treatment was provided if postoperative body temperature was > 37.5°C, or symptoms such as severe hematuria, hematochezia, urine retention, or obvious discomfort were observed.

Statistical Analysis

Dichotomous variables were analyzed with the chi-square test, and continuous variables were compared to Student's t-test using Statistical Package for the Social Science (SPSS Inc, Chicago, Illinois, USA) version 14.0. *P*-values < .05 were considered significant.

RESULTS

Detection Rate

A total of 122 patients were recruited; 46 (37.7%) cases were diagnosed with PCa (25 [40.3%] in the 18G group and 21 [35.0%] in the 20G group) (**Table 2**). PCa detection rate was not different between the two groups ($P > .05$).

Pain

Pain was assessed immediately after the puncture according to the Wong–Baker Facial Expression Scale (**Table 3**). Mean pain score was 1.821 ± 1.372 in the 18G group and 2.11 ± 1.580 in the 20G group. The differences in the three marks were significant in both groups ($P < 0.05$).

Complications

Gross hematuria occurred in 54 cases (44.3%): 38 patients (61.3%) in the 18G group and 16 (26.7%) in the 20G group ($P = .0001$). It usually occurred in the first urination after the biopsy, but all cases were self-limiting. No cases of severe bleeding were detected. No differences in blood hemoglobin or red blood cell count were observed between the first postoperative examination in the early morning and that at admission (P > .05). All cases received routine antibiotics (quinolones) postoperatively; seven cases (5.7%) developed infection accompanying a positive blood culture and/or a positive urine culture (6 [9.7%] in the 18G group and 1 [1.7%)] in the 20G group; $P = .0572$). Five cases (4.1%) developed fever (mean, 39°C; mean white blood cell count, 15.46 × 109/L; 4 [6.5%] in the 18G group and 1 [1.7%] in the 20G group; $P = .1826$), and all cases progressed to sepsis. Fever often developed within the first 3 days after biopsy. Severe infection symptoms were fever, chills, sweating, fatigue, accelerated heart rate, loss of appetite, and muscle aches. There were no cases of systolic blood pressure < 90 mmHg. Five patients recovered from infection after receiving 4–9 days of carbapenems or teicoplanin. No septic shock or death occurred. Eleven cases (9.0%) developed hematochezia (9 [14.5%] patients in the 18G group and 2 [3.4%] in the 20G group; $P = .0311$). Five cases (4.1%) developed dysuria. One case (1.6%) in the 18G group developed urinary retention (4 [6.5%] in the 18G group and one [1.7%] in the 20G group; $P = .1826$). The number of infectious complications was significantly different between the groups ($P < .05$) (**Table 4**).

DISCUSSION

TRUSPB is the primary approach for preoperative pathological diagnosis of PCa. TRUSPB images all prostate tissue clearly and simultaneously monitors the entire puncture process, allowing doctors to accurately obtain target tissue.[15] In this study, we prospectively evaluated results after using a smaller biopsy needle (20G) compared to the 18G needle, which is widely used for TRUSPB. The 18G needle had a diameter of 1.3 mm, length of 25 cm, and specimen slots of 1.9 cm. It can harvest 25.21 mm^3 of prostate tissue. In contrast,

Table 4. Complications in both study groups.

Variables	18G (n = 62)	20G (n = 60)	χ^2 Value	*P* Value
Hematuria	38 (61.3)	16 (26.7)	14.82	.0001
Infection	6 (9.7)	1 (1.7)	3.62	.0572
Fever (> 37.5°C)	4 (6.5)	1(1.7)	1.78	.1826
Hematochezia	9 (14.5)	2 (3.4)	4.65	.0311
Dysuria	4 (6.5)	1 (1.7)	1.7762	.1826

Data are presented as numbers (%).

a 20G biopsy needle has a diameter of 1.1 mm, length of 20 cm, sampling groove of 1.9 cm, and is also used for lung and thyroid biopsies. It samples less tissue, which could avoid unnecessary injury and complications. In the present study, all patients underwent the same procedure with different needles, and both procedures yielded satisfactory tissue samples. The 12-core puncture results showed an overall PCa detection rate of 37.7%, which is comparable to a retrospective TRUS-PB analysis of patients in our medical center from 1996 to 2007 in which the PCa detection rate was 39.8%. In the present study, the detection rates of the 18G and 20G groups were 40.3% and 35.0%, respectively ($P > .05$). Thus, the smaller needle did not significantly decrease the detection rate. Mean GS was also similar between the two groups. A moderate direct linear relationship has been reported between biopsy scores and prostatectomy specimens. However, underestimates of the actual GS of a radical prostatectomy specimen are common in low-grade tumors.[16] In our study, we found no differences in the GS during prostatectomy between the groups. Most of the 122 cases complained of piercing-like pain after the TRUSPB procedure. Thirteen patients complained of pain but completed the procedure. These symptoms were relieved after a short break and without providing additional analgesics.[17] The pain scores were significantly different between the groups ($P < .05$). TRUSPB pain was mainly caused by the insertion of the probe, penetration of the rectal mucosa with the biopsy needle, and stimulation of the prostate nerve when the needle punctured the prostate capsule.[17] Common postoperative complications of TRUSPB are hematuria, blood in the stool, acute urinary retention, blood in the sperm, and a vagal reflex.[18] Therefore, it might be necessary to minimize local injury with more careful handling, including using a thinner biopsy needle. Infections were the most serious complication. Lee and colleagues[19] reported that most surgical complications during TRUSPB are mild and without sequelae. Despite the preoperative bowel preparation, a small biopsy needle could introduce bacteria into the prostate or blood. We found significant differences in the frequencies of hematuria and hematochezia between the two groups ($P < .05$). The most frequent complication was gross hematuria, which was self-limiting and occurred mostly during the first urination but recovered after observation or symptomatic treatment. The incidence of gross hematuria was 44.3%, which may have been related to older age, anticoagulant use, inefficient pressure hemostasis, and the different puncture techniques.

Postoperative infection-related complications of TRUSPB include asymptomatic bacteriuria, urinary tract infection, febrile urinary tract infection, and sepsis.[20] Postoperative prophylactic antibiotics reduce the majority of infections, but rectal bacteria entering the blood can cause sepsis. In this study, seven cases (5.7%) developed serious infections, and all cases developed sepsis. However, no case proceeded to septic shock. Our results suggest that a 20G biopsy needle might reduce the incidence of postoperative infection compared to the commonly used 18G needle. TRUSPB using a 20G needle is a safe, simple, and less invasive way to improve early diagnosis and differential diagnosis of PCa from prostate disease. It not only maintained the PCa detection rate but reduced rectal and prostate injury, compared to the 18G needle. It could potentially decrease the incidence of complications, including hematuria, pain, and infection.

This is the first study to evaluate a 20G needle for TRUSPB. We discovered that the PCa detection rate was maintained using this needle. However, a few limitations of this study should be mentioned. First, the GS in both groups was determined only by the biopsy sample and was not verified with a sample taken during prostatectomy to confirm the accuracy of biopsies with different needles. Second, Chinese men appear to have lower PCa detection rates compared to Western men when using a PSA cutoff value > 4 ng/mL, which may have influenced the positive rate. However, no specific PSA level has been validated for Chinese men. Third, the number of patients in this study was small. Although the detection rates were 25% vs. 8% in the group with PSA < 4 ng/mL, the difference was not significant. Last, although the indicators for randomization including PSA level, PV, and DRE-positive rate were not different in this study ($P > .05$), the detection rate may not be a valid outcome in a series of patients with high-risk PCa (mean PSA > 55 ng/mL), in which cancer volume is sure to be high.

CONCLUSIONS

A 20G biopsy needle had a comparable PCa detection rate during TRUSPB compared to the 18G biopsy needle. It also decreased local injury, pain, and complications. Further controlled studies with larger sample sizes and a more precise randomization methods are needed to draw a final conclusion.

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Jianlong Wang and Ben Wan contributed equally to this study.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Heidenreich A, Bastian PJ, Bellmunt J, et al. EAU guidelines on prostate cancer. Part II: Treatment of advanced, relapsing, and castration-resistant prostate cancer. Eur Urol. 2014;65:467-79.
2. Ekin RG, Zorlu F, Akarken I, et al. Anterior apical cores in the initial prostate biopsy does not increase detection of significant prostate cancer. Urol J. 2015;12:2084-9.
3. Gleason DF, Mellinger GT. Prediction of prognosis for prostatic adenocarcinoma by combined histological grading and clinical staging. J Urol. 1974;111:58-64.
4. Yoon BI, Shin TS, Cho HJ, et al. Is it effective to perform two more prostate biopsies according to prostate-specific antigen level and prostate volume in detecting prostate cancer? Prospective study of 10-core and 12-core prostate biopsy. Urol J. 2012;9:491-7.
5. Jiang X, Zhu S, Feng G, et al. Is an initial saturation prostate biopsy scheme better than an extended scheme for detection of prostate cancer? A systematic review and meta-

analysis. Eur Urol. 2013;63:1031-9.

6. Bjurlin MA, Carter HB, Schellhammer P, et al. Optimization of initial prostate biopsy in clinical practice: sampling, labeling and specimen processing. J Urol. 2013;189:2039-46.
7. Eichler K, Hempel S, Wilby J, Myers L, Bachmann LM, Kleijnen J. Diagnostic Value of Systematic Biopsy Methods in the Investigation of Prostate Cancer: A Systematic Review. J Urol. 2006;175:1605-12.
8. Divrik RT, Eroglu A, Sahin A, Zorlu F, Ozen H. Increasing the number of biopsies increases the concordance of Gleason scores of needle biopsies and prostatectomy specimens. Urol Oncol. 2007;25:376-82.
9. Divrik RT, Eroglu A, Sahin A, Zorlu F, Ozen H. Extended prostate needle biopsy improves concordance of Gleason grading between prostate needle biopsy and radical prostatectomy. Urol Oncol. 2007;25:376-82.
10. Cicione A, Cantiello F, De Nunzio C, Tubaro A, Damiano R. Needle biopsy size and pathological Gleason Score diagnosis: No evidence for a link. Can Urol Assoc J. 2013;7:E567-71.
11. Xu G, Yao M, Wu J, et al. Diagnostic Value of Different Systematic Prostate Biopsy Methods in the Detection of Prostate Cancer with Ultrasonographic Hypoechoic Lesions - A Comparative Study. Urol Int. 2015;95:183-8.
12. Miyoshi Y, Furuya M, Teranishi J, et al. Comparison of 12- and 16-core prostate biopsy in japanese patients with serum prostate-specific antigen level of 4.0-20.0 ng/mL. Urol J. 2014;11:1609-14.
13. Garra G, Singer AJ, Domingo A, Thode HC Jr. The Wong-Baker pain FACES scale measures pain, not fear. Pediatr Emerg Care. 2013;29:17-20.
14. Bhanot N, Sahud AG, Sepkowitz D. Best practice policy statement on urologic surgery antimicrobial prophylaxis. Urology. 2009;74:236-7.
15. Hossack T1, Woo HH. Acceptance of repeat transrectal ultrasonography guided prostate biopsies with local anaesthesia. BJU Int. 2011;107 Suppl 3:38-42.
16. Tavangar SM, Razi A, Mashayekhi R. Correlation between prostate needle biopsy and radical prostatectomy Gleason gradings of 111 cases with prostatic adenocarcinoma. Urol J. 2004;1:246-9.
17. Hizli F, Argun G, Özkul F, et al. Novel approach for pain control in patients undergoing prostate biopsy: iliohypogastric nerve block with or without topical application of prilocaine-lidocaine: a randomized controlled trial. Urol J. 2015;12:2014-9.
18. Hwang EC, Jung SI, Seo YH, et al. Risk factors for and prophylactic effect of povidone-iodine rectal cleansing on infectious complications after prostate biopsy: a retrospective cohort study. Int Urol Nephrol. 2015;47:595-601.
19. Lee SH, Chen SM, Ho CR, Chang PL, Chen CL, Tsui KH. Risk factors associated with transrectal ultrasound guided prostate needle biopsy in patients with prostate cancer. Chang Gung Med J. 2009;32:623-7.
20. Shakil J, Piracha N, Prasad N, et al. Use of outpatient parenteral antimicrobial therapy for transrectal ultrasound-guided prostate biopsy prophylaxis in the setting of community-associated multidrug-resistant Escherichia coli rectal colonization. Urology. 2014;83:710-3.