Incidence of complications after transrectal ultrasonography-guided biopsy of the prostate in a local tertiary institution

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ABSTRACT

Introduction: This study aimed to evaluate the risk of complications for patients who received periprosthetic nerve block (PPNB) with one percent lignocaine before transrectal ultrasonography (TRUS) biopsy of the prostate.

Methods: From 2008 to 2009, data on 526 consecutive patients who underwent prostate biopsy was prospectively recorded and analysed. 475 (90.3 percent) patients received PPNB with 10 ml of one percent lignocaine (Group 1), which was carried out under TRUS-guidance and prior to biopsy. 51 (9.7 percent) patients received diclofenac (100 mg) intramuscular injections or no analgesia (Group 2). Complications were defined as any adverse effects after biopsy. Serious complications were defined as those requiring hospitalisation or invasive/operative procedures for treatment.

Results: At baseline, both groups were comparable. The mean prostate-specific antigen level in Group 1 was higher than that in Group 2 (48.6 +/− 13.8 versus 19.0 +/− 4.3 ng/ml; p-value is 0.04). There was no perioperative mortality. Post-procedural complications were reported in 23.4 percent (n is 111) of patients in Group 1 and 25.5 percent (n is 13) in Group 2 (p-value is 0.27). Serious complications were reported in 2.5 percent (n is 12) and 7.1 percent (n is 3) of Group 1 and 2 patients (p-value is 0.10), respectively. Both univariable and logistic regression revealed age below 65 years and pre-procedure complaints of lower urinary tract symptoms as independent predictors for complications (p-values are 0.02 and 0.006, respectively).

Conclusion: PPNB with one percent lignocaine is a safe analgesic procedure to perform in patients undergoing TRUS biopsy.

Keywords: complications, periprostatic nerve block, transrectal prostate biopsy

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INTRODUCTION

Transrectal ultrasonography (TRUS)-guided biopsy of the prostate is widely regarded as the gold standard for diagnosing prostate cancer. It is usually performed in the outpatient setting, as it is a considered a minor and safe procedure. Although it is well tolerated by most men, a considerable number of patients do complain of discomfort and pain. Various studies show that 65%–90% of patients complain of mild discomfort to severe pain.[1] Irani et al reported that up to 19% of patients would not undergo a repeat procedure without any form of anaesthesia.[2]

Periprostatic nerve block (PPNB) was first introduced by Nash et al[3] in 1996 and since then, various prospective clinical studies, including a meta-analysis, have shown that PPNB significantly reduces the pain score in patients when compared to a placebo[4,5] or other forms of analgesia such as intramuscular injections or rectal administration of non-steroidal anti-inflammatory drugs (NSAIDs) and intrarectal local anaesthesia.[4,6,7]

The most common complications after a TRUS biopsy are haematuria, urinary tract infections (UTIs), rectal bleeding and acute retention of urine. Some complications are serious enough to warrant hospitalisation and/or operative procedures for treatment. The rate of serious complications was 0.5%–6.6% in different studies.[8-10] Recent studies have re-highlighted the emerging significance of TRUS complications[11,12] as increasing number of biopsies and repeat biopsies are performed in an era of prostate-specific antigen (PSA) screening. Following our initial evaluation[4,6] and

subsequent introduction of PPNB to clinical practice, we prospectively evaluated the risk of complications for patients who received PPNB with 1% lignocaine before the TRUS biopsy, and compared it with patients who received intramuscular diclofenac or no analgesia.

METHODS

An Institutional Review Board (IRB)-approved database was developed to audit complications post-TRUS prostate biopsy after the introduction of PPNB at our institution. A total of 526 consecutive patients who underwent TRUS biopsy of the prostate from January 2008 to September 2009 were prospectively enrolled in our study. Indications for the biopsy were elevated serum PSA and/or abnormal digital rectal examination of the prostate. Anticoagulant or antiplatelet medications were stopped one week before the biopsy. Antibiotic prophylaxis with oral ciprofloxacin 500 mg was started one day before the biopsy and continued twice daily for a total of three days. A Dulcolax® suppository (Boehringer, Ingelheim, Germany) was self-administered by the patients on the morning of the biopsy.

The clinicians performing the procedures discussed with all the patients undergoing a TRUS-guided prostate biopsy concerning their preferred analgesia during the biopsy. The choice of analgesia was dependent on the clinician-patient discussion prior to the procedure. Group 1 consisted of 475 (90.3%) patients who had PPNB with 1% lignocaine performed under TRUS-guidance prior to the biopsy. Group 2 comprised 51 (9.7%) patients who had intramuscular injection of 100 mg diclofenac before the biopsy or no analgesia at all due to drug allergies. Only three patients in Group 2 opted for no analgesia.

For PPNB in Group 1, the patient was placed in the left lateral decubitus position. TRUS was performed using a Falcon 2101 Ultrasound Scanner with a 7.5-MHz transducer probe (BK Medical, Peabody, MA, USA). PPNB was performed by infiltrating 5 ml of 1% lignocaine to the neurovascular bundle on each side of the prostate using the outer sheath of the 18-gauge biopsy needle. With the US in the sagittal view, injection was given in the neurovascular bundle at the base of the prostate just lateral to the junction between the prostate and the seminal vesicle, as described earlier.[6] The syringe was aspirated before injection to ensure that a vascular structure was not entered. Proper positioning of the needle was confirmed by observing the separation of the seminal vesicle and prostate from the rectal wall caused by the injection. Patients in Group 2 proceeded directly to biopsy either with no analgesia or 20–30 minutes after analgesia.

Before biopsy, the prostate volume was measured by the non-planimetric ellipsoid formula. The presence of hypoechoic areas or calcifications on TRUS was noted on a standardised report form. Systematic core biopsies of the prostate were taken using an automatic spring-loaded biopsy gun with an 18-gauge Tru-Cut biopsy needle (CR Bard Inc, Covington, GA, USA). The number of core biopsies taken depended on the individual clinician's decision. All procedures were performed in the above standardised technique on an outpatient basis. All patients were reviewed 2–3 weeks after the procedure, and any complications reported during the visit were recorded in the clinical case notes. Complications that were additionally self-reported by the patients after the biopsy, including unscheduled post-procedure outpatient visits and phone calls to the outpatient clinic, were also captured in the clinical notes. Serious complications were defined as those requiring hospitalisation or interventions, including intravenous antibiotics, cystoscopic procedures or operations for treatment. These were recorded in the same unified outpatient and inpatient records.

Demographic data, PSA value, clinical and US parameters of the prostate, number of cores taken and complications were recorded for each patient in a computerised database by a dedicated database administrator, who reviewed all the clinical records and investigational results of the patients one month after the prostate biopsy. Statistical analysis was performed using the Statistical Package for the Social Sciences version 17 (SPSS, Chicago, IL, USA). Chi-square test was performed for categorical variables, and Student's *t*-test and ANOVA were used for analysis of continuous variables. Univariable and multivariable logistic regression were performed to assess the associated risk factors for post-procedural complications. A p-value < 0.05 was considered statistically significant.

RESULTS

At baseline, the two groups were comparable in terms of demographics, clinical and US parameters of the prostate and the number of cores taken for biopsy (Table I). In particular, there were no significant differences in the mean prostate volumes of both groups (44.2 ± 1.0 vs. 45.0 ± 4.0 ml, $p = 0.85$). However, the mean PSA level in Group 1 was higher than that in Group 2 (48.6 ± 13.8 vs. 19.0 ± 4.3 ng/ml, $p = 0.04$). Table II shows no statistically significant difference between the two groups in the histological outcomes of the biopsy, with prostate cancer diagnosed in 27.4% ($n = 130$) of Group 1 and 33.3% ($n = 17$) of Group 2 patients ($p = 0.41$).

Table I. Baseline demographic, clinical and ultrasonographic characteristics of patients in Group 1 (with PPNB) and Group 2 (without PPNB).

Patient characteristic	No. (%)		p-value
	Group 1(n = 475)	Group 2 (n = 51)	
Mean age ± SD (yrs)	65.7 ± 8.6	66.0 ± 8.7	0.84
Race			
Chinese	404 (85.1)	41 (80.4)	0.95
Malay	33 (6.9)	3 (5.9)	0.26
Indian	12 (2.5)	1 (1.9)	0.97
Others	26 (5.5)	6 (11.8)	0.27
Diabetes mellitus	81 (17.1)	6 (11.8)	0.22
On antiplatelet medications	40 (8.4)	5 (9.8)	0.45
On anticoagulant medications	5 (1.1)	1 (2.0)	0.51
Compliant to pre-medications*	427 (89.9)	39 (76.5)	0.94
LUTS pre-procedure	168 (35.4)	14 (27.5)	0.77
Mean PSA level ± SD (ng/ml)	48.6 ± 13.8	19.0 ± 4.3	0.04†
Abnormal digital rectal examination	113 (23.8)	13 (25.0)	0.23
Mean prostate volume on TRUS ± SD (ml)	44.2 ± 1.0	45.0 ± 4.0	0.85
Mean no. of cores taken ± SD	11.0 ± 1.7	10.8 ± 3.9	0.82
No. of repeat biopsies	30 (6.3)	5 (9.8)	0.49

* Pre-medications: antibiotics and suppository
† Statistically significant
PPNB: periprostatic nerve block; SD: standard deviation; LUTS: lower urinary tract symptoms; PSA: prostate-specific antigen; TRUS: transrectal ultrasonography

Table II. Histological outcome of TRUS biopsy of patients in Group 1(with PPNB) and Group 2 (without PPNB).

Histological outcome	No. of patients (%)		p-value
	Group 1 (n = 475)	Group 2 (n = 51)	
Benign prostatic hyperplasia only	263 (55.4)	24 (47.1)	0.94
Prostatitis documented	94 (19.8)	9 (17.6)	0.91
Cancer detected	130 (27.4)	17 (33.3)	0.41

Note: Some patients showed a combination of mutiple histological outcomes
PPNB: periprostatic nerve block; TRUS: transrectal ultrasonography

Table III. Demographic and clinical parameters of patients with complications (n = 111).

Parameter	No. (%)
Mean age ± SD (yrs)	63.9 ± 9.2
Mean PSA level ± SD (ng/ml)	76.63 ± 371.31
Mean prostate volume on TRUS ± SD (ml)	44.64 ± 20.46
Mean no.of cores taken ± SD	10.84 ± 1.66
Diabetes mellitus	18 (16.4)
On antiplatelet medications	10 (9.1)
On anticoagulant medications	2 (1.8)
No. of repeat biopsies	5 (4.5)

SD: standard deviation; PSA: prostate-specific antigen; TRUS: transrectal ultrasonography

The total complication rate reported in the two groups was 23.6% (n = 124). Table III shows the demographics and clinical parameters of patients who had complications. The overall complication rate (proportion of patients with at least one complication) was 23.4% (n = 111) in Group 1 patients and 25.5% (n = 13) in Group 2 (p = 0.27). The most commonly reported specific complications in both groups were gross haematuria and UTIs (Table IV). As there were patients who reported more than one specific complication, there was an overlap of patients in the different reported specific complications. The proportion of patients with gross haematuria in Group 2 (n = 9) was significantly higher than that in Group 1 (n = 36) (21.4% vs. 7.6%, p = 0.002). There was no significant difference between the two groups with regard to all other specific complications. No perioperative mortality was noted across the board.

The total serious complication rate (proportion of patients with at least one serious complication) for the two groups was 2.9% (n = 15). Serious complications were reported in 2.5% (n = 12) and 7.1% (n = 3) of Group 1 and 2 patients, respectively (p = 0.104), and only these patients were admitted for treatment. Table IV shows the breakdown of specific serious complications, with some patients having more than one serious specific complication. Due to the small number of patients in both groups, statistical comparison between the specific serious complications was not performed.

Table IV. Specific complications/serious complications of patients in Group 1 (with PPNB) and Group 2 (without PPNB).

	No. of patients (%)		p-value
	Group 1 (n = 475)	Group 2 (n = 51)	
Complication*			
Gross haematuria	36 (7.6)	9 (21.4)	0.002†
Acute urinary retention	27 (5.7)	2 (4.8)	0.89
Haematospermia	23 (4.8)	1 (2.4)	0.20
Urinary tract infection	12 (2.5)	1 (2.4)	0.29
Rectal bleeding	5 (1.1)	1 (2.4)	0.47
Serious complication*			
Gross haematuria	4 (0.8)	3 (5.9)	
Acute urinary retention	4 (0.8)	0	
Urinary tract infection	4 (0.8)	0	
Rectal bleeding	2 (0.4)	0	

* There was an overlap of patients with different specific complications/serious complications (i.e. some patients reported more than one complication).
† Statistically significant
PPNB: periprostatic nerve block

Table V. Univariable analysis of risk factors for overall complications.

Variable	OR; 95% CI	p-value
Age (yrs)		
< 65	1.56; 1.04–2.40	0.03
> 65	0.64; 0.42–0.96	
Race		
Chinese	0.68; 0.40–1.15	0.14
Others	1.48; 0.87–2.50	
History of diabetes mellitus		
No	1.07; 0.62–1.84	0.89
Yes	0.96; 0.56–1.66	
On anticoagulation medication		
No	0.61; 0.13–2.90	0.57
Yes	1.63; 0.30–9.01	
On antiplatelet medication		
No	0.83; 0.42–1.64	0.60
Yes	1.20; 0.60–2.41	
Compliance to pre-medication		
No	1.37; 0.73–2.59	0.33
Yes	0.73; 0.38–1.38	
Presence of LUTS pre-procedure		
No	0.58; 0.38–0.87	0.009
Yes	1.73; 1.64–2.62	
PSA level (ng/ml)		
< 10	0.98; 0.64–1.49	0.92
> 10	1.02; 0.67–1.56	
Indication for TRUS biopsy		
Abnormal DRE and raised PSA	1.49; 0.65–3.38	0.35
Abnormal DRE or raised PSA	0.67; 0.29-1.56	
Periprosthetic nerve block given		
No	1.54; 0.78–3.04	0.22
Yes	0.65; 0.33–1.30	
TRUS finding of hypoechoic nodules		
No	1.00; 0.62–1.62	1.00
Yes	1.00; 0.62–1.62	
TRUS finding of calcifications		
No	0.51; 0.19–1.37	0.19
Yes	1.98; 0.70–5.55	
TRUS prostate volume		
< 30	0.90; 0.57–1.42	0.65
> 30	1.11; 0.70–1.75	
Total no. of cores taken		
≤ 10	2.14; 0.32–14.30	0.49
> 10	0.47; 0.05–4.22	
TRUS prostate biopsy was a repeat procedure		
No	1.95; 0.80–4.74	0.15
Yes	0.51; 0.21–1.29	

OR: odds ratio; CI: confidence interval; LUTS: lower urinary tract symptoms; PSA: prostate-specific antigen; TRUS: transrectal ultrasonography; DRE: digital rectal examination

Clinical, US and demographic risk factors were analysed for their association with overall complications using both univariable and multivariable models, as shown in Tables V and VI. The mean age group of patients who had complications was significantly lower than those without complications (63.8 ± 9.4 vs. 66.2 ± 8.3 years, p = 0.01), although the difference was clinically small. On univariable analysis, age < 65 years (p = 0.03, odds ratio [OR] 1.56, 95% confidence level [CI] 1.04–2.4) and pre-procedure complaints of lower urinary tract symptoms (LUTS) (p = 0.009, OR 1.73, 95% CI 1.64–2.62) were significantly associated with overall complications. Multivariable logistic regression using these two factors in combination with PPNB confirmed age < 65 years and pre-procedure complaints of LUTS as independent predictors for overall complications (p = 0.02, OR 1.67, 95% CI 1.09–2.54 and p = 0.006, OR 1.80, 95% CI 1.18–2.74, respectively). The number of patients with serious complications was too small for meaningful analysis with the univariable and multivariable models.

DISCUSSION

Several studies have already shown that PPNB reduces pain from TRUS prostate biopsy.[4-7] Our previous study has ascertained that the pain score was lower in the PPNB group (diclofenac 3.70 ± 2.36 and PPNB 2.24 ± 1.63).[4] In our current population, the mean pain score for patients in the PPNB group (Group 1) was 1.16 ± 0.420 and that for Group 2 was 1.46 ± 0.636 (p = 0.004). Pain score was measured using the Wong-Baker FACES Pain Rating Scale, and none of the patients in this study had pain score > 3. The use of PPNB as an analgesia will become more widespread, since it is a relatively easy and quick procedure to perform just prior to biopsy. With this effective form of analgesia, patients would find TRUS

Table VI. Multivariable analysis of risk factors for overall complications.

Variable	OR; 95% CI	p-value
Age (yrs)		
< 65	1.67; 1.09–2.54	0.02
> 65	0.60; 0.39–0.91	
LUTS		
Yes	1.80; 1.18–2.74	0.006
No	0.56; 0.37–0.85	
Administration of PPNB		
Yes	1.55; 0.76–3.15	0.23
No	0.65; 0.32–1.31	

OR: odds ratio; CI: confidence interval; LUTS: lower urinary tract symptoms; PPNB: periprostatic nerve block

biopsy to be more acceptable, especially when a repeat biopsy or a higher number of cores is required for a more accurate diagnosis. In this prospective follow-up study, we have shown that the risk of overall complications and serious complications was not significantly increased following the introduction of PPNB into our clinical practice compared to intramuscular injection of diclofenac or no analgesia.

The predictable course and the close proximity of the prostatic neurovascular bundles to the rectal wall mean that they can be easily targeted and accessed by a US-guided needle for the injection of a local anaesthetic. However, there have been reported concerns that the injection of a local anaesthesia may increase bacteriuria and that more needle passes may cause greater rectal bleeding, both of which are already common in TRUS biopsies.[13] Although there are many published studies on the efficacy of PPNB in relieving pain from TRUS prostate biopsy, few other publications have specifically addressed complications from PPNB. The overall and serious complication rates of 23.6% and 2.9%, respectively, from this series are comparable to those reported in other studies.[8-10] With regard to PPNB, our finding of no increased overall complications is consistent with that of two other published reports.[13,14] Obek et al studied 100 patients who underwent TRUS biopsy with PPNB as analgesia in a prospective randomised trial, and concluded that there was no increased risk of urethral bleeding.[13] In a paper by Turgut et al, adverse effects associated with PPNB were reported to be mainly pain secondary to the needle puncture, lignocaine-associated problems and radiological changes in the prostate post biopsy. Only 1.5% of the 200 patients experienced post-procedure urinary incontinence; they also concluded that PPNB is a safe and effective analgesia for patients undergoing TRUS biopsy.[14]

No significant difference in specific complications (UTIs or rectal bleeding) between the PPNB and non-PPNB groups was found. Interestingly, the proportion of patients reporting gross haematuria in the non-PPNB (Group 2) was significantly higher when compared to that in Group 1 (21.4% vs. 7.6%), although the proportions of patients on antiplatelet or anticoagulation medications were equivalent between the two groups. The reason for this is unclear, as injections of the neurovascular bundles are relatively distant from the urethra. We do not routinely administer apical lignocaine injections to the prostate. However, the vast majority of cases with haematuria are self-resolving with conservative treatment and do not have serious implications. Maan et al reported no statistically significant difference in the incidence of haematuria or overall bleeding in patients who continued taking aspirin before and after the procedure, and concluded that aspirin does not have to be discontinued before the biopsy.[15] Despite this finding, all our patients who were on antiplatelet or anticoagulation medications were advised to discontinue them before biopsy, and this was confirmed before biopsy was performed.

When univariable and multivariable logistic regressions were performed, younger age and the presence of LUTS were found to be independent predictors for complications. In particular, age < 65 years was found to be significantly predictive of reported overall complications. However, the clinical difference may actually be smaller, as the mean ages of those who had complications and those without were close (63.8 ± 9.4 vs. 66.2 ± 8.3 years, p = 0.010). One possible reason may be that younger patients are more likely to self-report complications compared to older patients.

The presence of LUTS was an independent predictor of complications. The odds of patients with LUTS developing complications after prostate biopsy was 1.80 (95% CI 1.2–2.7) compared to patients who denied any LUTS, i.e. the 'true' PSA-screened patients. Hence, patients who undergo PSA screening probably are at a low risk of complications from TRUS biopsy. Therefore, with the pain issues addressed by PPNB, TRUS biopsy can become a truly acceptable follow-up investigation for patients identified by PSA screening.

Although the mean PSA level of the PPBN group was higher (48.6 ± 13.8 vs. 19.0 ± 4.3, p = 0.04) compared to the group without PPNB, the complication rate between the two groups is not significantly different. A higher PSA value can be attributed to either a larger prostate volume, the presence of prostate cancer or prostatitis, and this could translate to greater risk for complications; however, in our study, this was not evident.

Despite the link between complications and LUTS, TRUS prostate volume was not a significant predictor of complications, and there was no significant difference in the mean prostate volume between patients with and without complications (45.2 ± 21.5 vs. 43.9 ± 21.6 ml, respectively, p = 0.58). There is evidence to suggest that prostate volume is not the best indicator of bladder outlet obstruction, but other parameters, such as degree of intravesical prostatic protrusion are more predictive of bladder outlet obstruction and LUTS. This is currently the subject of our ongoing research.[16,17]

We acknowledge that there is a lack of randomisation in the study. The administration of PPNB did not allow for blinding. The number of patients in Group 1 (n = 475) was significantly higher, as we have adopted PPNB as the standard of care for TRUS biopsy in our institution. Hence, most patients would be offered this method of pain relief. However, we believe our results reflect the real-life clinical practice of introducing PPNB into clinical urological outpatients, with careful prospective recording of complications to document the safety of a new procedure. This study reflects the 'true' complication rate, with the patient's and clinician's choice of PPNB taken into account. In addition, by documenting both self-reported complications and serious complications, we believe that a complete picture of morbidity arising from PPNB and TRUS biopsy has been represented. This is important with the increasing attention given to post-biopsy complications, against the background of likely increasing advocates of PSA screening.[18] In conclusion, our study shows that PPNB with 1% lignocaine is a safe analgesic procedure to perform in patients undergoing TRUS biopsy, as it does not significantly increase the risk of overall and serious complications when compared to patients who did not have PPNB.

REFERENCES

1. Collins GN, Lloyd SN, Hehir M, McKelvie GB. Multiple transrectal ultrasound-guided prostatic biopsies--true morbidity and patient acceptance. Br J Urol 1993; 71:460-3.
2. Irani J, Fournier F, Bon D, et al. Patient tolerance of transrectal ultrasound-guided biopsy of the prostate. Br J Urol 1997; 79:608-10.
3. Nash PA, Bruce JE, Indudhara R, Shinohara K. Transrectal ultrasound guided prostatic nerve blockade eases systematic needle biopsy of the prostate. J Urol 1996; 155:607-9.
4. Tiong HY, Liew LC, Samuel M, Consigliere D, Esuvaranathan K. A meta-analysis of local anesthesia for transrectal ultrasound-guided biopsy of the prostate. Prostate Cancer Prostatic Dis 2007; 10:127-36.
5. Walker AE, Schelvan C, Rockall AG, Rickards D, Kellett MJ. Does pericapsular lignocaine reduce pain during transrectal ultrasonography-guided biopsy of the prostate? BJU Int 2002; 90:883-6.
6. Bhomi KK, Lim HH, Consigliere DT, Tiong HY. Control of pain during transrectal ultrasound-guided prostate biopsy: a prospective study comparing two methods. Urol Int 2007; 79:332-5.
7. Lynn NN, Collins GN, Brown SC, O'Reilly PH. Periprostatic nerve block gives better analgesia for prostatic biopsy. BJU Int 2002; 90:424-6.
8. Ecke TH, Gunia S, Bartel P, et al. Complications and risk factors of transrectal ultrasound guided needle biopsies of the prostate evaluated by questionnaire. Urol Oncol 2008; 26:474-8.
9. Raaijmakers R, Kirkels WJ, Roobol MJ, Wildhagen MF, Schrder FH. Complication rates and risk factors of 5802 transrectal ultrasound-guided sextant biopsies of the prostate within a population-based screening program. Urology 2002; 60:826-30.
10. Rodríguez LV, Terris MK..Risks and complications of transrectal ultrasound guided prostate needle biopsy: a prospective study and review of the literature. J Urol 1998; 160 (6 Pt 1):2115-20.
11. Lange D, Zappavigna C, Hamidizadeh R, et al. Bacterial sepsis after prostate biopsy--a new perspective. Urology 2009; 74:1200-5.
12. Hadway P, Barrett LK, Waghorn DJ, et al. Urosepsis and bacteraemia caused by antibiotic-resistant organisms after transrectal ultrasonography-guided prostate biopsy. BJU Int 2009; 104:1556-8.
13. Obek C, Onal B, Ozkan B, et al. Is periprostatic local anesthesia for transrectal ultrasound guided prostate biopsy associated with increased infectious or hemorrhagic complications? A prospective randomized trial. J Urol 2002; 168:558-61.
14. Turgut AT, Olçücüoğlu E, Koşar P, Geyik PO, Koşar U. Complications and limitations related to periprostatic local anesthesia before TRUS-guided prostate biopsy. J Clin Ultrasound 2008; 36:67-71.
15. Maan Z, Cutting CW, Patel U, et al. Morbidity of transrectal ultrasonography-guided prostate biopsies in patients after the continued use of low-dose aspirin. BJU Int 2003; 91:798-800.
16. Mariappan P, Brown DJ, McNeill AS. Intravesical prostatic protrusion is better than prostate volume in predicting the outcome of trial without catheter in white men presenting with acute urinary retention: a prospective clinical study. J Urol 2007; 178:573-7. Discussion 577.
17. Lim KB, Ho H, Foo KT, Wong MY, Fook-Chong S. Comparison of intravesical prostatic protrusion, prostate volume and serum prostatic-specific antigen in the evaluation of bladder outlet obstruction. Int J Urol 2006; 13:1509-13.
18. Schröder FH, Hugosson J, Roobol MJ, et al. Screening and prostate-cancer mortality in a randomized European study. N Engl J Med 2009; 360:1320-8.