

PSA, TZI, RI OF PROSTATE AS RISK FACTORS OF URINARY RETENTION

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ABSTRACT

Objective: To evaluate some parameters as the predictors of urine retention incident in Benign Prostate Hyperplasia (BPH) patients. **Materials & Methods:** From May to August 2012, a total of 24 BPH patients aged 47-69 years with lower urinary tract symptoms (LUTS) including 12 patients with urine retention were participated in the study. Prostate specific antigen (PSA) examination was performed on all patients. For urine retention patients, PSA was performed 2 weeks after catheterization as the procedure may affect PSA levels. Transrectal ultrasonography (TRUS) was examined to assess total prostate volume (VTP), transitional zone volume (VZT), transitional zone index (IZT = VZT / VTP), and resistive index of prostate capsular arteries. Statistic was utilized using simple and multiple logistic regression. Receiver operating characteristic (ROC) was calculated to assess the usefulness of parameters as a predictor of urine retention. **Results:** There was no significant difference in age between LUTS and BPH patients with urine retention ($p = 0,487$). There was no relationship between PSA and transitional zone index to incidence of urine retention in BPH patients (PSA; $p = 0,173$ and TZI; $p = 0,192$). Multiple logistic regression analysis showed only resistive index of prostate capsular arteries which correlates with urine retention incidence ($p = 0,014$), with area under ROC 0,865 (95% CI 0,721 to 1,008) and cut-off value of $> 0,675$ as a predictor of urine retention incidence. **Conclusion:** Resistive index of prostate capsular arteries by transrectal ultrasonography (TRUS) is a predictor of urine retention incidence in BPH patients.

Key words: prostate specific antigen, transitional zone index, resistive index of prostate capsular arteries, benign prostate hyperplasia, lower urinary tract symptoms, urine retention.

ABSTRAK

Tujuan: Mengevaluasi beberapa parameter sebagai prediktor kejadian retensio urine pada pasien Benign Prostate Hyperplasia (BPH). **Bahan & Cara:** Sejak bulan Mei sampai Agustus 2012, sebanyak 24 pasien BPH usia 47 – 69 tahun dengan keluhan lower urinary tract symptoms (LUTS) berpartisipasi dalam penelitian ini, 12 pasien diantaranya dengan retensio urine. Pemeriksaan prostate specific antigen (PSA) dilakukan pada semua pasien. Pemeriksaan PSA pada pasien dengan retensio urine dilakukan 2 minggu setelah pemasangan kateter saat kejadian retensio urine untuk menghilangkan pengaruh retensio urine terhadap peningkatan kadar PSA. Pada semua pasien dilakukan pemeriksaan transrectal ultrasonography (TRUS) untuk menilai volume total prostat (VTP), volume zona transisional (VZT), indeks zona transisional ($IZT = VZT/VTP$), dan resistif indeks arteri kapsularis prostat. Analisa statistik menggunakan regresi logistik sederhana dan ganda, serta penghitungan receiver operating characteristic (ROC) untuk menilai kegunaan parameter sebagai prediktor kejadian retensio urine. **Hasil:** Tidak terdapat perbedaan yang signifikan usia antara pasien BPH dengan LUTS dan retensio urine ($p = 0,487$). Tidak terdapat hubungan antara PSA dan indeks zona transisional terhadap kejadian retensio urine pada pasien BPH dengan tingkat kemaknaan PSA $p = 0,173$ dan indeks zona transisional $p = 0,192$. Analisa statistik regresi logistik ganda menunjukkan hanya resistif indeks arteri kapsularis prostat yang memiliki hubungan dengan kejadian retensio urine ($p = 0,014$), dengan area di bawah kurva receiver operating characteristic (ROC) 0,865 (95% CI 0,721-1,008) dan nilai cut-off $> 0,675$ sebagai prediktor kejadian retensio urine pada pasien BPH. **Simpulan:** Resistif indeks arteri kapsularis prostat yang dinilai menggunakan transrectal ultrasonography (TRUS) merupakan prediktor kejadian retensio urine pada pasien dengan BPH.

Kata kunci: prostate specific antigen, indeks zona transisional, resistif indeks arteri kapsularis prostat, benign prostate hyperplasia, lower urinary tract symptoms, retensio urine.

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INTRODUCTION

BPH is a benign enlargement of the prostate, histologically can be found in patients above 41 years of age, causing obstruction of the lumen of the urethra and LUTS and decreasing quality of life in patients with urine retention.^{1,2} Acute urinary retention is an emergency in the field of urology, marking the inability to initiate micturition that occurs suddenly accompanied by suprapubic pain.^{3,4,5} Urine retention in BPH patients may occur spontaneously or triggered by other factors such as anesthesia or consumption of α -sympathomimetic and anticholinergic drugs.³ Bladder Outlet Obstruction (BOO) caused by BPH can be ascertained by standard urodynamic examination.⁶ In addition, there are other tests that are non-invasive method to determine the presence of BOO such as PSA, TZI examination and resistive index (RI) of prostate capsular arteries.⁷ By finding the level of PSA, TZI, and RI of prostate capsular arteries, the incidence of urine retention in BPH patients can be predicted.

MATERIALS & METHODS

From May 2012 to August 2012, as many as 60 BPH patients were participated in the study. Among those, 25 patients came with urine retention. Exclusion criteria including bladder stones, prostate and bladder malignancy, urethral stricture, diabetes mellitus, history of previous prostate surgery, and previous medical treatment. PSA examination was performed on all patients. For urine retention patients, PSA was performed 2 weeks after catheterization as the procedure may affect PSA level.

TRUS was examined using GE Voluson 730 Pro ultrasound V (probe RIC5-9H 6,5 MHz) to

measure prostate volume and prostate transitional zone volume. Transitional zone index was obtained by dividing transitional zone volume with total prostate volume. Five Mhz-Doppler frequency was used with a repetition frequency of 1-3 kHz. After finding of at least 5 pulsatile waveform, peak systolic flow velocity (PSV), end diastolic flow velocity (EDV), and resistive index ($RI = [PSV-EDV] / PSV$) were calculated. PSA, TZI, and RI of the transitional zone of each patient were recorded and analyzed statistically using simple and multiple logistic regression. All statistical analysis was considered significant if $p < 0,05$.

RESULT

Of the 60 patients with BPH, 26 patients were excluded, including 31 patients with age ≥ 70 years, 4 patients because of bladder stones, and 1 patient with previous prostate surgery, leaving 12 patients with BPH-LUTS and 12 patients with BPH-urine retention. Of 60 BPH patients, the mean age for BPH-LUTS was $59,83 \pm 6,65$ years and BPH-urine retention $61,58 \pm 5,40$ years. There were no significant differences between the two groups ($p = 0,487$) (Table 1). In urine retention patients, examination of PSA was done twice, at the time of acute urine retention and 2 weeks after when the catheter was removed. There were significant differences in PSA levels at the time of urine retention with PSA levels 2 weeks after catheter placement ($p = 0,024$) (Table 2). Table 3 shows PSA levels in BPH-LUTS as well as BPH-urine retention. Simple logistic regression revealed $p = 0,173$ which means no relationship between PSA levels with the incidence of urine retention.

Transitional zone index data obtained from the study subjects, mean $0,42 \pm 0,17$ in the BPH-LUTS group and $0,5 \pm 0,08$ in the BPH-urine retention group. Regression test showed $p = 0,192$.

Table 1. Characteristics of subjects by age.

	LUTS (n=12)		Urine Retention (n=12)		p
	Mean	S.D	Mean	S.D	
Age	59,83	$\pm 6,65$	61,58	$\pm 5,40$	0,487

Table 2. PSA characteristics in BPH patients during AUR and after the catheter removal.

	During Acute Urine Retention (n=12)		After Catheter Removal (n=12)		p
	Mean	S.D	Mean	S.D	
PSA	9,72	$\pm 7,76$	8,44	$\pm 7,11$	0,024

Table 3. Logistic regression of PSA levels.

	Mean	S.D	Min	Max	OR	P
LUTS	4,6	5,33	0,5	20,4	1,122 (0,951-1,324)	0,173
Urine Retention	8,44	7,11	0,6	25,8		

Table 4. Logistic regression of transitional zone index.

	Mean	S.D	Min	Max	OR	P
LUTS	0,42	0,17	0,26	0,92	132,046 (0,087-201139,4)	0,192
Urine Retention	0,5	0,08	0,38	0,67		

Table 5. Logistic regression of RI of prostate capsular arteries.

	Mean	S.D	Min	Max	OR	p
LUTS	0,64	0,09	0,52	0,78	$5 \times 10^7 (34,37-7 \times 10^{13})$	0,014
Urine Retention	0,75	0,06	0,61	0,84		

Table 6. Multiple logistic regression test between PSA levels, TZI, and RI of prostate capsular arteries.

	B	OR	p
PSA	0,136	1,146 (0,930-1,413)	0,201
IZT	-3,59	0,027 (0,00-101,37)	0,391
RI	17,688	$5 \times 10^7 (34,37-7 \times 10^{13})$	0,014

Resistive index value derived from the prostate using TRUS Doppler examination revealed a mean of $0,64 \pm 0,09$ and $0,75 \pm 0,06$ in BPH-LUTS and BPH-urine retention group, respectively. Regression test showed $p = 0,014$ (table 5).

Multiple logistic regression was calculated from the 3 parameters used as predictors of urinary retention incidence and revealed only RI of prostate capsular arteries associated with the incidence of urinary retention ($p = 0,014$), whereas PSA levels and TZI with $p = 0,201$ and $p = 0,391$, respectively (table 6).

ROC curve was used to assess the accuracy of RI of prostate capsular arteries as a predictor of urine retention incidence with area under the curve 0,856 (95% CI 0,721 to 1,008) (Figure 1). Cut-off value of this RI is 0,675 with a sensitivity 92%, specificity 67%, positive predictive value 73%, and negative predictive value 89% (Table 7)

Table 7. Sensitivity, specificity, positive predictive value, and negative predictive value for urine retention at different values of RI.

Cut-off RI	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
$\geq 0,75$	67%	83%	80%	71%	75%
$\geq 0,725$	67%	83%	80%	71%	75%
$\geq 0,70$	83%	67%	71%	80%	75%
$\geq 0,675$	92%	67%	73%	89%	79%
$\geq 0,650$	92%	50%	65%	86%	71%

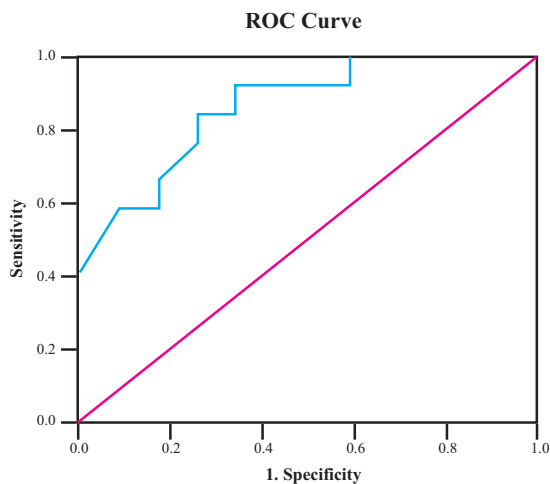


Figure 1. ROC curve of RI of prostate capsular arteries.

DISCUSSION

The association between PSA levels and prostate volume,⁸ showed that prostate volume increased with BOO and urine retention, causing PSA levels can be used as a risk factor for urine retention in BPH patients.^{2,3,9} It should be noted on PSA examination of urine retention patient that PSA levels may significantly different during AUR and when the catheter was removed, 2 weeks afterward ($p = 0,024$). It is recommended that PSA should be checked at least 2 weeks after catheterization in urine retention patients to eliminate the influence of AUR, as described earlier by Aliasgari's study.¹⁰ Elevated PSA levels mechanisms due to urine retention remains unclear. Assumptions is due to infarction in prostate.¹⁰ In this study, PSA levels can not be used as a predictor of urine retention incidence ($p = 0,173$), in contrast to the study by Milonas (2003)² in which the PSA cut-off value is $> 3\text{ng/dl}$, this may be caused by differences in the inclusion criterias and the time of PSA sampling.

Increase of prostate volume in BPH patients due to increase of transitional zone causes compression of peripheral zone, central zone, as well as the urethra which in turn causing BOO.^{2,11} Kaplan in 1995 used urodynamic testing to prove the association between TZI and the incidence of prostate obstruction.¹² In this study we found $p = 0,192$ which means the TZI can not be used as a predictor of the incidence of urine retention, while $\text{OR} = 132,046$ indicates the greater the transitional

zone index value, the greater the possibility of urine retention. Milonas in 2003 found that transitional zone index can be used as a predictor of urine retention incidence with cutoff 0,62. The same study was done by Kurita in 1998 which revealed a cut-off of 0,65 to predict urine retention.¹³ The difference between our study and previous studies is the restriction of the study subjects age (50-70 years). Another possibility is that prostate volume of Indonesian men is relatively smaller than that of European, but there has not been any study which compares prostate volume of Indonesian men with that of Asian or European. While in one study, prostate volume of Japanese men is smaller than that of American men.¹⁴

Another effect of transitional zone volume increase is the suppression of peripheral zone to prostate capsule, which will be followed by an increase in intraprostatika pressure and RI of prostate capsular arteries.^{4,15} Logistic regression test was performed from RI BPH-LUTS and BPH-urine retention groups with results $p = 0,014$ ($\text{OR} = 5 \times 107$), meaning there is a relationship between RI of prostate capsular arteries with urine retention. Therefore, it can be used as a predictor of urine retention incidence in BPH patients, whereas a high value of OR shows that the higher the value of RI, the greater the likelihood of urine retention. In this case, patients with high value of RI has a probability of urine retention 5×107 times compared to normal. Shinbo (2012) conducted a similar study and found mean RI for BPH-LUTS as high as $0,702 \pm 0,073$ and BPH-urine retention $0,815 \pm 0,069$, as well as showed significant differences between RI BPH-LUTS and urinary retention ($p 0,001$).⁴ It should be noted that not all patients with BPH-LUTS or urine retention had RI increase. Medial lobe enlargement without any enlargement of the lateral lobes cause no increase of RI.¹⁶ This is possible because of unique prostate anatomy where there is no compression of prostatic capsular arteries by two lateral lobe. In this case, intravesical prostatic protrusion (IPP) was used to determine the level of BOO.¹⁶

In this study, we found the amount of ROC 0.865 (95% CI 0,721 to 1,008) on the parameters of RI of prostate capsular arteries. We found 0.675 as the best cut-off value with sensitivity 92%, specificity 67%, positive predictive value 73%, negative predictive value 89%, and accuracy of 79%. Study by Shinbo (2010) obtained ROC 0.867 (95% CI 0,851 to 0,882) with a cut-off value of 0,75, and the sensitivity 80,4%, specificity 76,5%, positive

predictive value 33,2%, and negative predictive value 96,4%.⁴

CONCLUSION

Resistive index of prostate capsular arteries correlates with the incidence of urine retention in BPH patients and can be used as a predictor of urine retention incidence. The best cut-off value is 0,675.

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