

# prostatic capsular artery resistive index and male Boo

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**Submission date:** 20-Nov-2019 11:11AM (UTC+0800)

**Submission ID:** 1217602037

**File name:** prostatic\_capsular\_artery\_resistive\_index\_and\_male\_Boo.pdf (109.19K)

**Word count:** 2104

**Character count:** 10992

## PROSTATIC CAPSULAR ARTERY RESISTIVE INDEX AND MALE BOO

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### ABSTRACT

**Objective:** This study aims to explore the relationship between resistive index (RI) with clinical parameters and degree of bladder outlet obstruction (BOO). **Materials & Methods:** We performed clinical examination which included IPSS, uroflowmetry, transrectal prostate ultrasonography for measurement of prostatic volume and RI of prostatic capsular artery, and pressure flow study. We enrolled patients with lower urinary tract symptoms (LUTS) and prostatic volume of more than 20 ml. Statistical analysis utilised correlation and calculation of sensitivity, specificity, and area under curve of receiver operating characteristics. **Results:** Twenty-six patients provided consent to enroll in this study. Mean age was 66,5 ± 6,56 years, mean IPSS was 15,9 ± 7,27, and mean prostatic volume 36,0 ± 23,78. Kolmogorov-Smirnov test showed normal distribution of all study variables. There was significant correlation between RI and IPSS, Qmax, and BOO ( $p < 0,05$ ). Correlation coefficients ( $r$ ) for prostatic volume and BOO was 0,392 ( $p = 0,048$ ), for Qmax and BOO was -0,515 ( $p = 0,007$ ), and RI with BOO was 0,414 ( $p = 0,035$ ). Using cutoff values for  $RI \geq 0,70$  and  $BOO \geq 4$ , we found sensitivity of 70,0%, specificity of 50,0%, positive predictive value of 46,7% and negative predictive value of 72,7%. **Conclusion:** Resistive index of prostatic capsular artery is correlated with BOO and has a role in diagnosis of BOO in men with LUTS related to Benign Prostatic Hyperplasia (BPH).

**Keywords:** Resistive index, transrectal power doppler ultrasonography, lower urinary tract symptoms, bladder outlet obstruction.

### ABSTRAK

**Tujuan Penelitian:** Penelitian ini bertujuan untuk mempelajari hubungan antara resistive index (RI) dengan parameter pemeriksaan klinis dan derajat bladder outlet obstruction (BOO). **Bahan & Cara:** Kami melakukan pemeriksaan klinis yang meliputi IPSS, uroflowmetri, ultrasonografi transrektal, pengukuran indeks resistif arteri kapsularis prostat dan pressure flow study pada penderita yang datang dengan keluhan lower urinary tract symptoms (LUTS) dan volume prostat lebih dari 20 ml. Analisis statistik menggunakan uji korelasi dan perhitungan sensitivitas, spesifisitas dan luas bidang di bawah kurva receiver operating characteristics. **Hasil Penelitian:** Dua puluh enam pasien bersedia mengikuti penelitian ini dengan rerata usia 66,5 ± 6,56 tahun, rerata IPSS 15,9 ± 7,27, dan rerata volume prostat 36,0 ± 23,78. Dari uji Kolmogorov-Smirnov, semua variabel penelitian berdistribusi normal. Didapatkan hubungan yang signifikan antara RI dengan IPSS, Qmax, dan BOO ( $p < 0,05$ ). Hubungan yang signifikan didapatkan antara volume prostat dengan BOO ( $r = 0,392$ ,  $p = 0,048$ ), Qmax dengan BOO ( $r = -0,515$ ,  $p = 0,007$ ) dan RI dengan BOO ( $r = 0,414$ ,  $p = 0,035$ ). Penggunaan nilai cutoff  $RI \geq 0,70$  dan  $BOO \geq 4$ , menghasilkan sensitivitas 70,0%, spesifisitas 50,0%, nilai prediksi positif 46,7%, dan nilai prediksi negatif 72,7%. **Simpulan:** RI arteri kapsularis prostat berhubungan dengan derajat BOO dan dapat berperan pada penegakan diagnosis BOO pada pasien LUTS terkait Benign Prostatic Hyperplasia (BPH).

**Kata Kunci:** Resistive index, transrectal power doppler ultrasonography, lower urinary tract symptoms, bladder outlet obstruction.

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## INTRODUCTION

Benign prostatic hyperplasia (BPH) is the most frequent benign neoplasm in men and contributes to development of lower urinary tract symptoms (LUTS) in men.<sup>1</sup> There are various causes of LUTS in men, either obstructive due to BPH, urethral stricture, lower urinary tract stones, and or non obstructive due to bladder over- and under activity. Invasive urodynamic studies, including cystometry and pressure flow study, are the reference standard for determination of bladder outlet obstruction (BOO) as etiology of LUTS.<sup>2</sup>

Transrectal power Doppler ultrasonography imaging results in measurement of the resistive index (RI) of prostatic capsular arteries. RI increases significantly in BPH and decreases after treatment.<sup>3</sup>

## OBJECTIVES

This study aims to compare RI of prostatic capsular arteries with current clinical variables in management of LUTS, including International Prostate Symptom Score (IPSS), peak urinary flow rate (Qmax), prostatic volume, and degree of BOO.

## MATERIALS & METHODS

We enrolled men with enrolled men older than 50 years of age with lower urinary tract symptoms presenting to the outpatient clinic of the Department of Urology, Soetomo Hospital Surabaya. Patients with lower urinary tract lithiasis, neurological disease, urethral stricture, coronary and peripheral vascular disease found on examination or past medical records were excluded. All subjects completed an IPSS questionnaire, uroflowmetry, transrectal prostate volume measurement and transrectal power doppler ultrasonography. This study employed the GE Voluson 730 Pro V with the RIC 5-9H endoluminal probe.

All subjects underwent pressure flow study performed with the Medtronic Duet according to

published standards,<sup>4</sup> and degree of obstruction was determined by Schaefer diagram.<sup>5</sup> Statistical analyses performed were Kolmogorov-Smirnov test for normality and Pearson correlation coefficient using commercially available statistics package. We defined statistically significant a p value of < 0,05.

## RESULTS

We enrolled 26 subjects in this study with characteristics shown in table 1. Kolmogorov-Smirnov test of normality on all study variables showed consistency with normal distribution assumptions ( $p > 0,05$ ). There was significant correlation between RI and IPSS, RI and Qmax, and RI and BOO ( $p < 0,05$ ). There was no significant correlation between RI and prostatic volume ( $p > 0,05$ ).

We found significant correlation between prostatic volume with BOO, Qmax with BOO, and RI with BOO ( $p < 0,05$ ).

**Table 1.** Patient characteristics.

	Value (mean $\pm$ SD)
Age (years)	66,5 $\pm$ 6,56
IPSS	15,9 $\pm$ 7,27
Prostatic volume (ml)	36,0 $\pm$ 23,78
Peak urinary flow rate (ml/s)	12,1 $\pm$ 8,47
RI	0,710 $\pm$ 0,0804
BOO	3,15 $\pm$ 1,32

**Table 2.** Correlation of RI with clinical variables in LUTS.

Correlation	Correlation Coefficient	P
RI with IPSS	0,456	0,019
RI with prostatic volume	0,193	0,344
RI with Qmax	-0,467	0,016
RI with BOO	0,414	0,035

**Table 3.** Correlation of BOO with clinical variables in LUTS.

Correlation	Correlation coefficient	p
IPSS with BOO	-0,120	0,560
Prostatic volume with BOO	0,392	0,048
Qmax with BOO	-0,515	0,007
RI with BOO	0,414	0,035

**Table 4.** Diagnostic test properties of RI in determining BOO.

BOO Cut-off	AUC ROC	RI Cut-off	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
BOO $\geq 3$	0,714	$\geq 0,70$	63,2%	57,1%	80,0%	36,0%
		$\geq 0,75$	31,6%	71,4%	75,0%	28,0%
BOO $\geq 4$	0,703	$\geq 0,70$	70,0%	50,0%	46,7%	72,7%
		$\geq 0,75$	40,0%	75,0%	50,0%	66,7%
BOO $\geq 4^*$	0,738	$\geq 0,70$	80,0%	50,0%	33,3%	88,9%
		$\geq 0,75$	40,0%	75,0%	33,3%	80,0%
BOO $\geq 5$	0,614	$\geq 0,70$	60,0%	42,9%	20,0%	81,8%
		$\geq 0,75$	40,0%	71,4%	25,0%	83,3%

**DISCUSSION**

BPH often presents with LUTS and BOO. Presence of BOO is an important factor in predicting results of treatment, especially with invasive nature. BPH related growth of the transitional zone creates pressure, transmitted to prostatic capsular vessels as well as increasing urethral luminal pressure. Measurement of prostatic capsular artery RI is a less invasive diagnostic modality to determine presence of BOO. This measurement is performed during routine transrectal ultrasonography.

We studied values of RI in patients with LUTS related BPH, and determined relationship with urodynamic obstruction and other routine clinical parameters. RI is moderately correlated with IPSS, Qmax, and BOO. RI is not correlated with prostatic volume. In relation to BOO, RI has a correlation coefficient almost equal to prostatic volume and slightly smaller than Qmax. Diagnostic accuracy of RI for BOO diagnosis is highest at RI  $\geq 0,70$  and BOO  $\geq 4$ , with sensitivity of 70,0% and

specificity 50,0%.

Study subjects had mean age of 66,5 years, with largest symptom group with moderate LUTS. Mean prostate volume was 36,0 ml. Mean degree of BOO was 3,15. These figures show subject characteristics similar to previous studies with moderately symptomatic men.<sup>6,8</sup>

Relationship of RI and prostatic volume was not significant in this study, which differs from previous reports.<sup>7,8</sup> A smaller average prostate volume in this study may include patients with smaller prostates and more storage symptoms. Relationship of prostate volume with BOO was similar to previous reports.<sup>7,9</sup> Relationship of RI and BOO was not directly possible due to difference in grading of obstruction.

Diagnostic accuracy of tests for BOO is shown in table 7. RI has moderate sensitivity and specificity for BOO compared to other diagnostic tests. Combination of diagnostic measures may result in better accuracy for determination of BOO.

**Table 5.** Comparison of RI in relation to other clinical parameters.

Correlation	This study	Shinbo et al (2010) <sup>10</sup>	Tsuru et al (2002) <sup>8</sup>	Kojima et al (2000) <sup>7</sup>
RI - IPSS	0,456	0,31	0,389	
RI - Prostatic Volume	0,193		0,470	0,515
RI - Qmax	-0,467	0,33	-0,393	

**Table 6.** Comparison of BOO in relation to other clinical parameters.

Correlation	This study	Wadie et al (2001) <sup>9</sup>	Kojima et al (2000) <sup>7</sup>
IPSS - BOO	-0,120	0,05	
Prostatic volume BOO	0,392	0,4	0,515
Qmax - BOO	-0,515	-0,40	0,360 (P det Q max)
RI - BOO	0,414		0,330 (AG number)

**Table 7.** Diagnostic accuracy of various modalities for BOO <sup>4,6</sup>

Diagnostic test	Sensitivity	Specificity
This study	70,0	50,0
RI > 0,7	85	46
LUTS		
Poor stream	94	8
Terminal dribbling	94	7
Intermittency	89	13
Hesitancy	84	19
Residual urine > 50 ml	87,5	35
Prostatic volume > 40 g	49	32
Presumed Circle Area Ratio	77	75
Intravesical Prostatic Protrusion		
Grade I	7	56
Grade II	17	53
Grade III	76	92
Bladder Wall Thickness		
> 5 mm	54	92
> 2 mm	64	97
Bladder Weight > 35 g	85	87
Qmax < 10 ml/s	47	70

## CONCLUSION

RI of prostatic capsular artery is correlated with BOO. Correlation coefficient of RI with BOO is higher than IPSS with BOO and prostatic volume with BOO. RI has good diagnostic accuracy for diagnosis of BOO in men with BPH related LUTS.

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