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ORIGINAL ARTICLE

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Correlation of Prostate Volume and Intravesical Prostatic Protrusion with Detrusor Wall Thickness using Transabdominal Ultrasonography in Benign Prostate Enlargement: A Preliminary Study

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ABSTRACT

Aim: Assessed the correlation between prostate volume and intravesical prostatic protrusion with detrusor wall thickness through transabdominal sonographic examination of benign prostate enlargement (BPE). **Methods:** The study is a paired-group analytical observational cross-sectional study during April – July 2020. Measurements were made of prostate volume, intravesical prostatic protrusion, and detrusor wall thickness using transabdominal sonography. An analysis was carried out to determine the correlation with bivariate analysis and the calculation of the research power. **Results:** Thirty-four BPE patients with a mean age of 62.41 years were included in the study. The mean value of prostate volume obtained was 44.24 cc; 8.66 mm for intravesical prostatic protrusion; and detrusor wall thickness is 1.49 mm. The correlation value between prostate volume and detrusor wall thickness was 0.12 (p=0.46), while the intravesical prostatic protrusion and detrusor wall thickness were 0.37 (p=0.03). The research power for correlating prostate volume with detrusor wall thickness and intravesical prostatic protrusion with detrusor wall thickness was 10-20% and 50-60%, respectively. **Conclusion:** There is a very weak correlation between prostate volume and detrusor wall thickness and a weak correlation between the intravesical prostatic protrusion and detrusor wall thickness. Other variables may influence the thickness of the detrusor wall.

Keywords: benign prostate enlargement, detrusor wall thickness, intravesical prostatic protrusion, prostate volume.

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INTRODUCTION

Longer human life expectancy results in an increase in degenerative diseases, one of which is benign prostate enlargement (BPE). The prevalence of BPE is estimated to increase in the next few decades. According to Biro Pusat Statistik, in Indonesia, the population older than 65 will increase up to 10.6% in 2035 (doubling up compared to 2010) (BPS 2013).[1] Meanwhile, 50% of men have prostate hyperplasia pathologically.[2-4] In untreated, BPE could result in complications such as urine retention to kidney failure. BPE also affects the quality of life of the patients.[4]

Chronic bladder obstruction will result in structural changes such as thickening of the detrusor wall.[5-8] Assessment of bladder outlet obstruction (BOO) in sonography should include static (prostate volume (PV), intravesical prostatic protrusion (IPP)), and dynamic (detrusor wall thickness (DWT)) components.[9] However, the common practice

of sonographic reporting of BPE generally only includes PV. The study aimed to assess the correlation between prostate volume and intravesical prostatic protrusion with detrusor wall thickness through transabdominal sonographic examination of BPE.

METHODS

The study is an analytical observational with a cross-sectional study design. The study has received institutional ethical clearance.

The study sample is male patients who met the inclusion criteria, BPE patients, and age equal to or older than 50 years old. Patients with a score of International Prostate Symptom Score (IPSS) equal to or more than eight and a prostate volume of more than 20 ml were categorized as BPE. Exclusion criteria including Patients with a history of bladder surgery, bladder stone, prostatic cancer, pelvic trauma, or diabetes mellitus.

The study measured PV, IPP, and DWT. All measurements were done using transabdominal ultrasonography (Logiq P7; GE Healthcare, United States). Before the measurements, the bladder should be distended (at least 200 ml in volume). PV was measured using an automated sonography tool using craniocaudal, transverse, and anteroposterior distance (**Figure 1**).

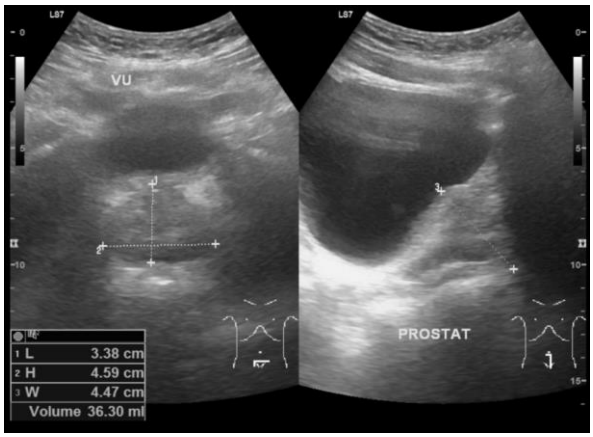

Figure 1. Prostate volume calculation with transabdominal ultrasonography on transverse and longitudinal plane.

IPP is the vertical distance from the edge of protruded prostate to the bladder wall (**Figure 2**). IPP measurements categorized into grade 1 (< 5 mm), grade 2 (5-10 mm), and grade 3 (> 10 mm). DWT is the distance between the inner and outer detrusor muscle (hypoechoic band between hyperechoic lines). Measurement of DWT was done on three different spots with an interval of 1.0 cm, and the mean value was recorded (**Figure 3**). PV and IPP measurements were done using a curvilinear transducer; meanwhile linear transducer was used to measure DWT.

Statistical analysis was done using Statistical Package for the Social Science (SPSS) 20.0. A p-value of < 0.025 was used as a threshold for significance where relevant.

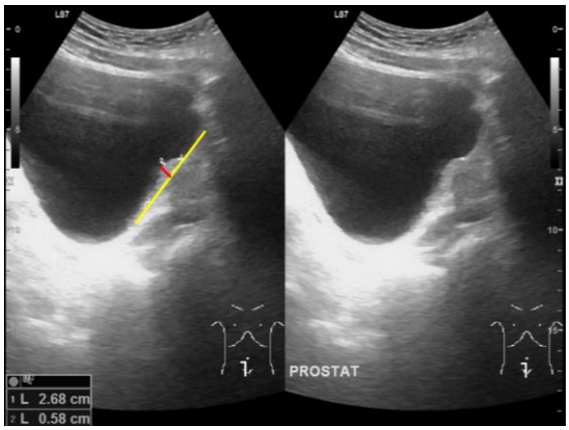

Figure 2. Intravesical prostatic protrusion (red line) measurement with transabdominal ultrasonography on a longitudinal plane. The yellow line shows the base of the bladder.

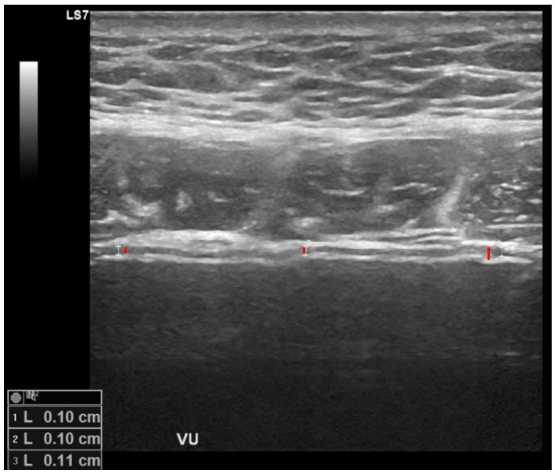

Figure 3. The red line shows detrusor wall thickness on a transverse plane of transabdominal ultrasonography. VU: vesica urinaria.

RESULTS

A total of 34 samples were included in the study. Demographic characteristics and measurement results are summarized in **Table 1**. Correlation between PV and IPP with DWT was analyzed using the Spearman test. The p-value for PV and DWT was 0.46. For IPP and DWT, the p-value was 0.03. Besides p-value, the study also assessed r-value and research power. The results are shown in **Table 2**. **Figure 4** and **Figure 5** represent scatterplot graphs for PV and IPP with DWT.

Table 1. Characteristics of The Study Subjects

Variable	Total (n = 34)
Age (year)[a]	62.41 ± 8.34
IPSS score[a]	16.74 ± 6.29
IPSS score category[b]	
Moderate	21 (61.8%)
Severe	13 (38.2%)
Prostate volume (cc)[a]	44.24 ± 19.24
Intravesical prostate protrusion (mm)[a]	8.66 ± 7.00
Intravesical prostate protrusion grade[b]	
Grade 1	9 (26.5%)
Grade 2	17 (50.0%)
Grade 3	8 (23.5%)
Detrusor wall thickness (mm)[a]	1.49 ± 0.51

[a]Mean ± standard of deviation; [b]frequency (%)

Table 2. p-value, r-value, and research power of PV and IPP with DWT

Correlation	p-value	r-value	Z_β	Power (1- β)
Prostate volume with detrusor wall thickness	0.46	0.12	-1.32	10-20%
Intravesical prostatic protrusion with detrusor wall thickness	0.03	0.37	0.18	50-60%

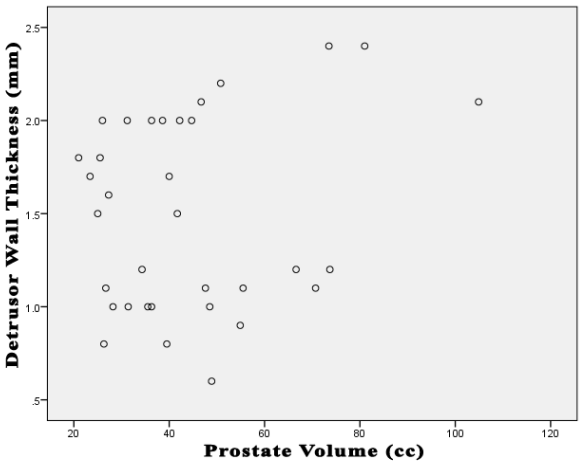

Figure 4. Scatterplot graph of PV and DWT.

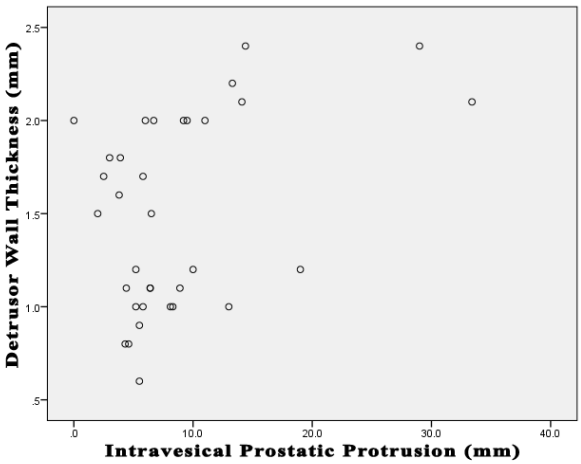

Figure 5. Scatterplot graph of IPP and DWT.

DISCUSSION

The research subjects are 34 patients with BPE. The mean value of their age was 62.41 years old. This finding follows the literature that mentioned that most men in their fifth and sixth decade have BPE.[10-12]

The mean value of PV and IPP was 44.24 ml and 8.66 mm, respectively. Half (50%) of IPP were categorized as IPP grade 2, 26.5% as grade 1, and the rest (23.5%) were grade 3. The mean value for DWT was 1.49 mm.

Bivariate analysis of PV with DWT and IPP with DWT revealed p-value 0.46 and 0.03, respectively. Those two p-values are more than the study threshold (p-value < 0.025), meaning there is no statistical correlation between those variables. The dots

are distributed randomly on the scatterplot graph of PV and DWT, forming no straight line. The same thing was observed in the scatterplot graph of IPP and DWT. The graphs showed no correlation or near-zero correlation.

The r-value of PV and DWT was 0.12, which is a very weak correlation between these two variables. Meanwhile, the r-value of IPP and DWT was slightly larger (0.37). There is a weak correlation between IPP and DWT. The results showed that DWT was probably affected by other variables outside the variable of the study. This result contradicts the literature, stating that BOO is a contributing factor in the thickening of detrusor walls.[8,13-15]

Research power for PV and DWT was 10-20%; meanwhile, power for IPP and DWT was 50-60%. The value of the powers shows type II error (false-negative) is probable of 80-90% for PV with DWT and 40-50% for IPP with DWT.

The authors tried to analyze the cause-effect between PV and IPP with DWT based on Bradford Hill criteria. The r-value of the study is similar to other studies: 0.107-0.549 for PV with DWT[5,16] and 0.427 for IPP with DWT.[16] There is a significant difference statistically (coherence). The study shows no significant correlation; however, other studies showed correlations significantly.[5,16] Based on the scatterplot graphs, the biological dose criteria were not fulfilled. The literature has explained biologically plausible and temporal relationships between BOO and DWT.[8,13-15] These differences between the study and previous studies show a lack of consistency. However, it should be proved in further researches.

The study has limitations, especially in the size of the samples. The small size of the samples affects the research power. Unfortunately, the study was conducted during the beginning phase of the COVID-19 pandemic, where large-scale social restrictions significantly reduced patients' hospital visits.

CONCLUSION

The preliminary study shows there is no correlation between PV with DWT and IPP with DWT. Further researches are needed to study the correlation, evaluate, and standardized sonography report in BPE cases.

DISCLOSURE

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