71

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THE DIAGNOSTIC EFFICACY OF THREE DIMENSIONAL ULTRASOUND ESTIMATED BLADDER WEIGHT CORRECTED BY BODY SURFACE AREA AS AN ALTERNATIVE NON-URODYNAMIC PARAMETER OF BLADDER OUTLET OBSTRUCTION.

Hypothesis / aims of study

The gold standard method for diagnosing bladder outlet obstruction (BOO) is the pressure-flow study (PFS), but it is invasive, time-consuming, costly and psychologically stressful. BOO leads to positive compensatory bladder hypertrophy, collagen deposition and finally increased bladder weight aimed to overcome the resistance to bladder empting. Recently, several studies suggested ultrasound estimated bladder weight (UEBW) as a useful non-urodynamic parameter in screening, diagnosis and follow-up after treatment of BOO[1, 2]. UEBW is a measurement derived from the ultrasound measured bladder thickness and calculated bladder surface area. In the present study, we investigated the association between corrected UEBW, UEBW divided by body surface area (BSA), with BOO index (BOOI) from the PFS and evaluated its diagnostic efficacy for predicting BOO.

Study design, materials and methods

Between June 2006 and July 2007, consecutive series of 193 men (>age 50) with lower urinary tract symptoms (LUTS) without prior pharmacological or surgical treatment and underlying neurological disease were investigated with bladder wall thickness (BWT)/UEBW measurement and PFS. All patients completed the IPSS (International Prostate Symptom Score) questionnaire. Written informed consent was obtained before study procedures were commenced. BWT/UEBW were measured with using a battery-powered 3D hand-held ultrasound system, the BladderScan® BVM 6500 device (Diagnostic Ultrasound, Bothell, WA). We added new developed parameter "corrected UBEW" defined as UEBW divided by BSA in data analysis. BOOI was calculated by PdetQmax-2Qmax of PFS and the study population were classified into obstructed (≥40) and unobstructed (<40). The correlation analysis between urodynamic parameters predicting BOO and UEBW/corrected UEBW was performed with the Spearman's test. In addition, receiver operator characteristics (ROC) curves and calculation of the area under the curve (AUC) were obtained to determine the diagnostic accuracy of UEBW and corrected UEBW for BOO. Sensitivity, specificity, positive predictive value (PPV) for diagnosing BOO was calculated at each cut-off point of corrected UEBW. A p value ≤ 0.05 was considered statistically significant and SPSS version 12.0 was used in statistical analysis.

Results

The mean ± S.D. of BOOI and BWT were 30.5±24.8 and 2.3±0.33mm. The UEBW and corrected UEBW ranged from 33 to 66g (48.2±6.8g) and from 18.23 to 41.67g/m^2 (27.34±3.97g/m^2), respectively. Based on the criteria of BOOI, we categorized 50 patients (26%) as obstructed group (BOOI≥40) and 143 (74%) as unobstructed group (BOOI<40). In comparison of clinical parameters between two groups, only three parameters, corrected UEBW (p=0.035), Q-max (p<0.001), blabber contraction index (BCI) (p<0.001) showed statistically significant difference (Table 1). Stratification of our cases by the BOOI resulted in a significant difference in the mean values of corrected UEBW between the group with BOOI ≥ 40 and BOOI <20 (28.5g/m^2 vs 26.3g/m^2, p=0.009, 1-way ANOVA test) (Fig. 1). A significant positive correlation was noted when the corrected UEBW was compared to the BOOI, PdetQmax, BCI and the highest correlation coefficient was observed between corrected UEBW and BCI (r = 0.530, p<0.001), followed by PdetQmax (r = 0.251, p<0.001) and the BOOI (r = 0.235, p=0.002). UEBW also showed significant correlation with BOOI (r = 0.152, p=0.034) but the correlation was weaker than that of corrected UEBW. The AUC of ROC curve analysis for evaluating diagnostic value of UEBW and corrected UEWB demonstrated larger AUC in corrected UEBW and was 0.539 and 0.609, respectively. The cut-off value of corrected UEBW in the ROC curve was 28g/m^2 with sensitivity 61.9%, specificity 59.8%, PPV 33.8%, respectively.

Interpretation of results

The present study demonstrated that UEBW divided by BSA, new parameter we defined as corrected UEBW showed meaningful difference between obstructed and unobstructed group and statistically significant but weak correlation with BOOI. Previous suggested parameter, UEBW showed also significant correlation with BOOI, but the correlation coefficient and AUC in the ROC curve were smaller than those of corrected UEBW (r=0.152 vs 0.235, AUC=0.539 vs 0.609). Form these findings, we found that measurement of corrected UEBW was more precise test to predict BOO than UEBW and its diagnostic sensitivity, specificity and PPV at cut-off 28g/m^2 were 61.9%, 59.8%, 33.8%. In spite of correlation with BOO of corrected UEBW measured by 3D ultrasound, the low correlation coefficient and low PPV suggested that this parameter is alone not sufficient diagnostic marker in predicting BOO.

Concluding message

UEBW divided by BSA was analyzed as statistically significant parameter correlating with BOO. But corrected UEBW alone is not sufficient to predict BOO because of weak correlation with BOO and low sensitivity, low specificity and low PPV for diagnosing BOO. Therefore it cannot be a definitive alternative method of gold standard PFS yet.

Table. Comparison of clinical characteristics between two groups (mean ± S.D)

Variable	AG number < 40 (n=143, 74%)	AG number ≥ 40 (n=50, 26%)	p-value
Bladder wall thickness, mm	2.3±0.31	2.3±0.39	0.467
UEBW, g	47.9±6.8	49.2±6.8	0.124
Corrected UEBW(UEBW/BSA), g/㎡	27.0±4.0	28.3±3.7	0.035
Qmax, mL/s	11.7±5.0	7.67±3.4	<0.001

PVR, mL	9.4±26.3	10.4±23.1	0.351
BCI	100.9±28.5	116.1±27.2	<0.001
IPSS	19.9±8.8	19.9±8.4	0.903

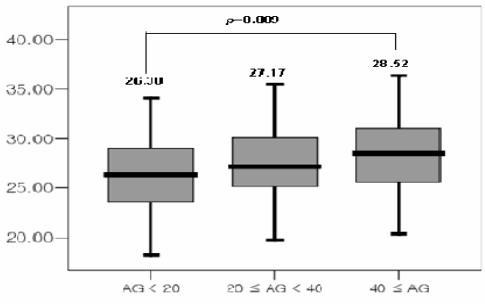
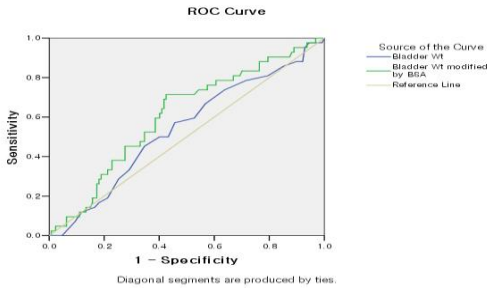


Figure 1. The one-way ANOVA analysis of UEBW corrected by BSA of unobstructed(BOOI<20), equivocal (20≤BOOI<40) and obstructed (BOOI≥40)



AUC : UEBW = 0.539 corrected UEBW = 0.609

Figure 2. ROC curve analysis of UEBW and corrected UEBW for diagnosis BOO.

Reference

1. Urology (1996) 47; 942-947.
2. Rev Urol (2005) 7(suppl 6); S29-S34.

Specify source of funding or grant	**No**
Is this a clinical trial?	**Yes**
Is this study registered in a public clinical trials registry?	**No**
What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**Samsung Medical Center IRB**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**