Correlation between obesity-related measurements and initial and initial resting intravesical and abdominal pressures in urodynamic study using air-charged catheter system

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ABSTRACT

Urodynamic study (UDS) is widely used for the diagnosis of lower urinary tract dysfunction. The UDS performance and quality of this specific process directly determine the stability and accuracy of the results. In the 1970s, air-filled catheter (AFC) was proposed to attenuate artifacts due to patient movement and cancel signals that are high-frequency [1,2]. However, although AFC was widely used, there was a significant difference between pressures recorded by the water-filled catheter (WFC) and AFC systems, such as the measurement of initial resting intravesical pressure (Pves) and abdominal pressure (Pabd) in UDS. In WFC system, it has been reported that body mass index (BMI) correlated with Pves and Pabd [3,4]. Currently, there is a lack of published studies characterizing the correlation of initial resting pressures of the AFC system with these obesity-related measurements. This study aims to firstly establish the initial (before pressure equilibrium) and initial resting intravesical and abdominal pressure of AFC system in UDS testing, to assess the correlation between these pressures and obesity-related measurements, and to estimate if obesity-related measurements can be a guide to interpret initial and initial resting pressures in the UDS testing.

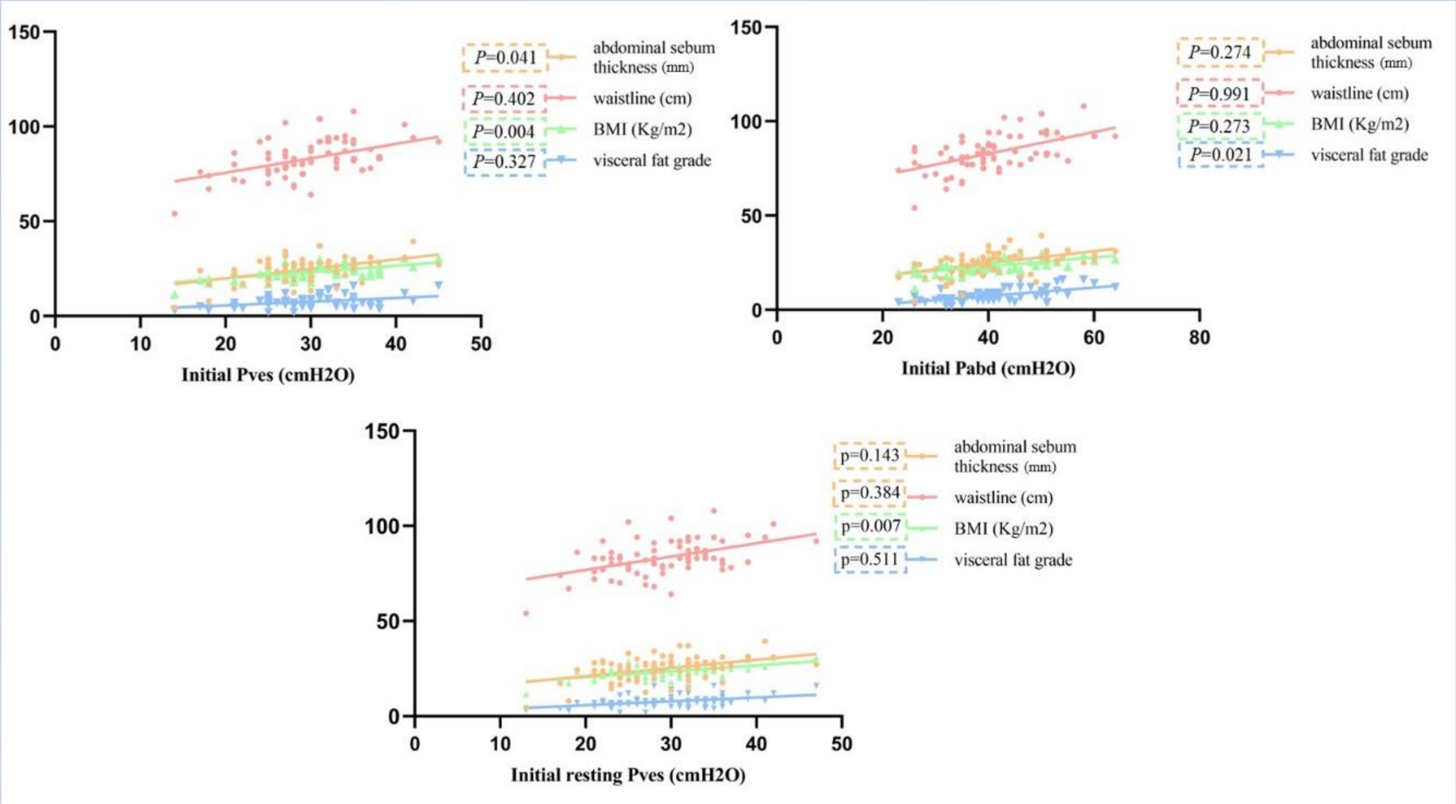
METHODS

This study was conducted in our UDS center from August 2022 to October 2022. Patients with non-neurogenic lower urinary tract symptoms (LUTS) referred for UDS were prospectively enrolled. Conventional pressure flow studies were carried out in the sitting position using the AFC system. Catheters were inserted in the open position and the connector then switched to the “charge” position after the transducer exposed to the surrounding atmospheric pressure were set to zero. We recorded the initial Pves and Pabd at this moment. Then we clicked Pabd = Pves for pressure equilibrium. The initial resting Pves, Pabd, and calculated detrusor pressure (Pdet = Pves − Pabd) were recorded after confirming the ‘‘live’’ signal tracing (the same pressure transmission while coughing) before filling. After the UDS procedure, BMI, weight, fat, muscle, and visceral fat grade were recorded using Direct Segmental Multi-Frequency Bioelectrical Impedance Analysis Method. The abdominal sebum thickness and waistline were also recorded. The initial and initial resting pressures were also expressed as 50% range (equivalent to the interquartile range). The correlation between initial and initial resting pressures and obesity-related measurements, including abdominal sebum thickness, waistline, BMI, weight, height, fat, and visceral fat grade, was studied using Pearson correlation coefficient. Then we used multiple linear regression analysis for further investigation (weight, height, and fat were not considered because of the effect of multicollinearity). Data was processed with the SPSS 24.0 and statistical significance was defined as $P < 0.05$.

Variable	Mean ± SD	Median	50% range
Abdominal sebum thickness (mm)	24.6 ± 6.3	26	20.3-28.1
Waistline (cm)	83.0 ± 9.6	83	78.0-89.0
Body mass index	23.2 ± 3.6	23.2	21.1-25.5
Visceral fat grade	7.6 ± 3.3	7	5.0-9.0
Height (mm)	160.4 ± 8.5	159	154-168
Weight (Kg)	59.1 ± 10.8	57.1	52.3-65.6
Musscle (Kg)	22.8 ± 5.1	22	19.3-25.8
Fat (Kg)	17.0 ± 5.7	16.6	12.6-20.4
Initial Pves (cmH2O)	29.7 ± 6.1	30	27.0-34.0
Initial Pabd (cmH2O)	40.3 ± 9.9	39	35.0-46.0
Initial resting Pves (cmH2O)	29.1 ± 6.3	29	24.0-33.0
Initial resting Pabd (cmH2O)	28.7 ± 6.7	29	24.0-32.0
Initial resting Pdet (cmH2O)	0.22 ± 1.9	0	-1.0-1.0

RESULTS

Ninety-eight patients aged 56±16 were studied. The 50% range of the initial Pves ranged between 27.0 - 34.0 cmH2O and Pabd ranged between 35.0 - 46.0 cmH2O. While the initial resting Pves, Pabd, and Pdet ranged between 24.0 - 33.0, 24.0 - 32.0, and -1.0 - 1.0 cmH2O, respectively (shown in Table), which falls closely in line with the previous similar type of study [5]. Analysis of Pearson correlation coefficient revealed a significant correlation between initial pressures and obesity-related measurements. Initial Pves was positively correlated with abdominal sebum thickness, waistline, BMI, visceral fat grade, weight, and fat, with no significant correlation with height. The initial Pabd showed high correlation with abdominal sebum thickness, waistline, BMI, visceral fat grade, weight, and fat, while there was no correlation with height and muscle. Related factors were included in the multiple linear regression analysis. The results of the multiple linear regression analysis indicating a significant correlation between initial Pves and abdominal sebum thickness and BMI ($r=0.651$, $p=0.041$ and $p=0.004$, respectively), but no correlation with waistline and visceral fat grade. The results of the multiple analysis also show only visceral fat grade maintained a significant correlation with initial Pabd ($r=0.679$, $p=0.021$) (shown in Figure). For the initial resting pressures, we only analyzed the correlation between initial resting Pves and obesity-related measurements, because the value of initial resting Pabd was close to the initial resting Pves after the pressure equilibrium procedure. The results of Pearson’s correlation coefficient indicated a significant correlation between initial resting Pves and abdominal sebum thickness, waistline, BMI, visceral fat grade, weight, muscle, and fat, with no significant correlation with height. Regardless of weight, height, and fat, only BMI maintained a significant correlation with initial resting Pves over the multiple analysis ($r = 0.608$, $P=0.007$) (shown in Figure).



CONCLUSIONS

Our results firstly carried out the values of both initial and initial resting pressures, and revealed that the obesity-related indexes were positively correlated with the corresponding bladder and rectal pressures in the AFC system UDS testing. In the UDS procedure, ensure that the initial or initial resting Pabd and Pves values are within the normal range estimated based on the obesity index, a good initial and initial resting pressure quality control can be better obtained. Though currently there is still a lack of the estimating model, our study showed the obesity-related measurements might be used as a guide to interpret the initial and initial resting pressures in urodynamic testing, and might provide a reference for the quality control of these pressures.

REFERENCES

1. Cooper MA, Fletter PC, Zaszczurynski PJ, Damaser MS (2011) Comparison of air-charged and water-filled urodynamic pressure measurement catheters. Neurourol Urodyn 30 (3):329-334. doi:10.1002/nau.20991

2. James ED (1978) The behaviour of the bladder during physical activity. Br J Urol 50 (6):387-394. doi:10.1111/j.1464-410x.1978.tb04216.x

3. Madjar S, Balzarro M, Appell RA, Tchetgen MB, Nelson D (2003) Baseline abdominal pressure and valsalva leak point pressures-correlation with clinical and urodynamic data. Neurourol Urodyn 22 (1):2-6. doi:10.1002/nau.10073

4. Noblett KL, Jensen JK, Ostergard DR (1997) The relationship of body mass index to intra-abdominal pressure as measured by multichannel cystometry. Int Urogynecol J Pelvic Floor Dysfunct 8 (6):323-326. doi:10.1007/bf02765589

5. Deng H, Liao L, Wu J, Li X, Pang D, Liu Q, Wang X, Li X, Liang Yn, Zhou Z, Luo R, He P (2023) Typical value ranges and signal patterns in patients with neurogenic bladder: Quality control in urodynamics using an air-charged catheter system. Neurourology and Urodynamics 42 (1):113-122. doi:https://doi.org/10.1002/nau.25055