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RESEARCH ARTICLE

DIFFERENT FEATURES OF NON-INVASIVE PARAMETERS IN PATIENTS WITH DETRUSOR UNDERACTIVITY COMPARED WITH NORMAL DETRUSOR CONTRACTILITY

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ABSTRACT

Background: To explore the correlation between non-invasive sonography video urodynamic (SVUDS) parameters, including PV, PVR, Qmax, and BWT, and bladder detrusor contractility. **Methods:** Clinical data of 448 male patients, who underwent SVUDS from September 2021 to December 2023, were retrospectively collected. The associations between non-invasive SVUDS parameters and WFmax were assessed using Spearman correlation. All patients were divided into two groups according to WFmax, in which WFmax in group A including 99 patients were less than 7W/m^2 and was considered DU and WFmax in group B including 349 patients $\geqslant$7W/m^2 which was considered normal detrusor contractility. The difference of non-invasive SVUDS parameters between DU and normal detrusor contractility was analyzed using one-way ANOVA. **Results:** There was a negative correlation between WFmax and PVR (r=-0.352, P<0.01), and weak positive correlations between WFmax and Qmax (r=0.218, P<0.01), PV (r=0.123, P <0.01), and BWT (r=0.130, P <0.01) were found. The PVR of patients in group A was significantly higher than that of group B, and PV, Qmax and BWT in group A were significantly lower than those in group B (P<0.01). **Conclusion**: Higher PVR, lower Qmax, smaller PV, and thinner BWT were significantly associated with DU compared with normal detrusor contractility when the cut-off value of WFmax between DU and normal detrusor contractility was determined at 7W/m^2.

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INTRODUCTION

Detrusor Underactivity (DU) is one of common causes of lower urinary tract symptoms (LUTS). Urodynamics study (UDS) is the "gold standard" in evaluation of bladder detrusor contractility (BDC) (1). Poor BDC has a negative significant impact on patients' quality of life (2). WFmax has been recognized as the best UDS parameters in assessing BDC, which presents some features of detrusor contractility such as contraction pressure and duration (3). However, time-consuming and potential bleeding of UDS hindered facilitation of clinical application of pressure-flow study (PFS)(4). Therefore, previous researches have failed to replace the invasive pressure-flow study of UDS with non-invasive methods using the cut-off value between DU and normal detrusor contractility at 10W/m^2. In this study, the relationship between non-invasive parameters of sonography video urodynamic studies (SVUDS), including PV, PVR, Qmax, and BWT, and WFmax was analyzed to find which parameters can significantly differentiate DU from normal detrusor contractility if WFmax$<$7W/m^2 was used as the diagnosis standard of DU.

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PARTIPANTS AND METHODS

Participants: Clinical data of 448 male patients who underwent UDS in Shaoyang Central Hospital from September 2021 to December 2023 were retrospectively collected. Patients were diagnosed with central or peripheral nervous disorders, endocrine diseases, and urethral stenosis and associated with history of pelvic surgery or radiotherapy and urethral trauma, all which potentially affecting lower urinary tract, were excluded from the present study.

Methods

The urodynamic analysis machine (Andromeda, German) and DC-65 Doppler (Mindray, Chian) were used in the present study.

Urodynamic examination was performed by the same urologist. Qmax was obtained using free-flow study, and WFmax was automatically determined using software attached to Amdormeda. Residual urine volume (PVR), prostate volume (PV), and bladder wall thickness （BWT） and was measured by transabdominal ultrasound, in which PVR and PV was obtain using the equation: right to left diameter (cm) × anteroposterior diameter (cm) × upper to lower diameter (cm) × 0.52. The associations between non-invasive SVUDS parameters and WFmax were assessed using correlation analysis. All patients enrolled in the study were divided into two groups according to WFmax, in which WFmax in group A were less than 7W/m^2 and was considered DU and WFmax in group B ⩾7W/m^2 which was considered normal detrusor contractility. The difference of non-invasive SVUDS parameters, including PV, PVR. BWT, and PVR, between DU and normal detrusor contractility were analyzed using one-way ANOVA.

Effectiveness assessment: SPSS2.0 statistical software was used for analysis, and the data of each group were tested for normality. All data was tested for normality, and mean ± standard deviation (X±S) was used for continuous variables with normal distribution, while the median (quartile) (M (P25-P75)) was presented for data without normality. Pearson correlation analysis and T-test were used for data with normal distribution, whereas Spearman correlation analysis and Mann-Whiteny U test were used for non-normal distribution. P<0.05 was considered statistically significant.

RESULTS

448 male patients enrolled in the study, a median negative correlation between WFmax and PVR (r=-0.352, P < 0.01) and weak positive correlations between WFmax and PV (r=0.123, P < 0.01), Qmax (r=0.218, P < 0.01)，and BWT (r=0.130, P < 0.01) were showed in the Spearman correlation analysis in the study (Figure 1).

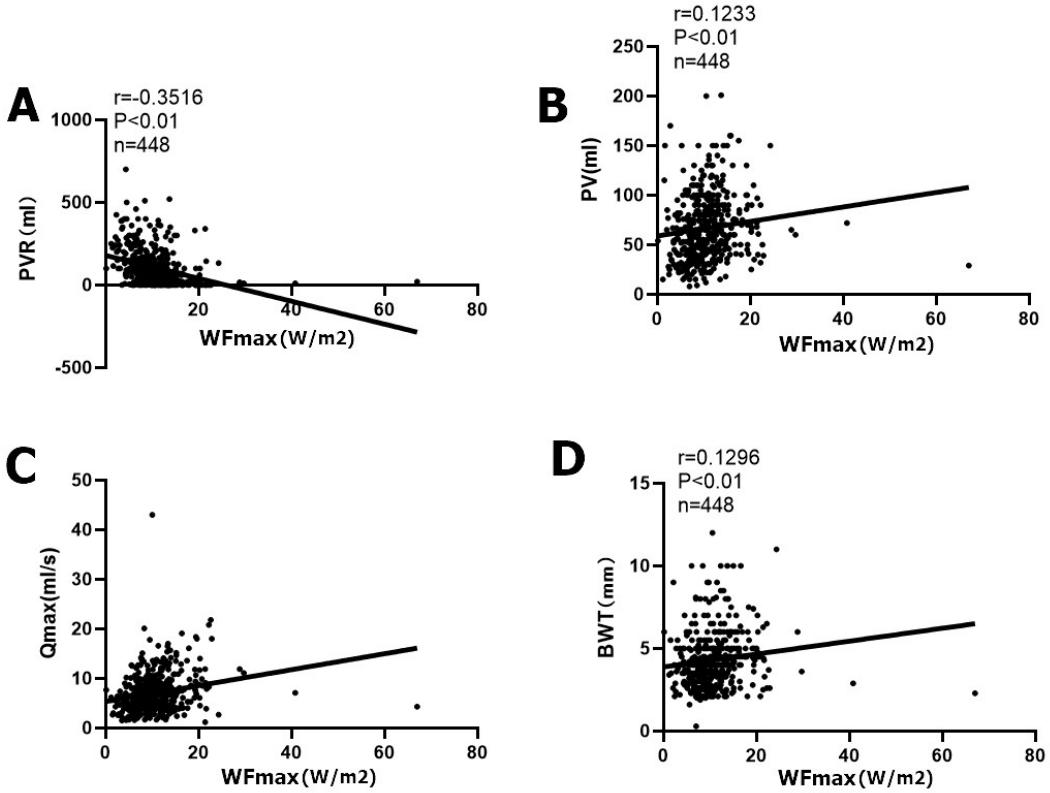
All patients was divided into two group according to WFmax, in which 99 patients were diagnosed with DU (group A, WFmax＜7W/m^2) and 349 patients were considered as normal detrusor contractility (group B, WFmax≥7W/m^2) (5). Although One-way ANOVA showed that there was no significant difference in age between group A and group B (P=0.187), larger PVR (P<0.01), smaller PV (P<0.01), lower Qmax (P<0.01), and thinner BWT (P=0.012) were found in patients with DU compared to those of group B (Table 1).

DISCUSSION

In 2002, the International Continence Association (ICS) defined detrusor underactivity (DU) as ‘Reduced intensity and/or duration of detrusor contraction that resulting in prolonged duration of bladder emptying and/or inability to achieve complete bladder emptying in the normal time of micturition based on invasive urodynamic examination (PFS), and patients are often complained hesitant urination, weakened filling sensation, slow urine flow and other feelings’ (6). At present, the pathogenesis of DU has been not clearly clarified and more researches will be needed. It is generally suggested that neurogenic, myogenic and idiopathic etiologies may be involved within DU.

Incidence of lower urinary tract symptoms (LUST), including frequency, urgency, nocturia, dysuria, intermittent voiding, incomplete micturition, urinary incontinence and urinary retention, has been proven to increase with aging and severely affects the quality of life of the elderly, resulting to gradually globally increasing of economic burden consuming on treatment of LUST. 25%-48% of LUTS in old men and 12%-24% of LUTS in old women have been respectively reported to be on accounted of DU (7). However, DU only is diagnosed using invasive pressure-flow study (PFS) of urodynamic studies (UDS) that may result to high examination cost, urethral pain and bleeding, to which few patients can accept UDS at initial phase of differentiation diagnosis of LUST due. Therefore, it is not uncommon that DU was frequently omitted in the diagnosis and treatment of LUTS due to lack of evidence of urodyanmically proven detrusor underactivity. Although Maximum detrusor pressure (Pdet.max) can directly represent detrusor pressure and WFmax has been reported to be considered a better parameter of detrusor contraction ability when compared with bladder contraction index (BCI), invasive nature of urethral catheterizationduring UDS hindered facilitation of clinical application of Pdet.max, WFmax and BCI(8). In the recent decades, some non-invasive parameters, including PV, PVR, Qmax, and BWT, has been used to evaluate their efficiency in differential diagnosis capacity of DU with controversial results. 10W/m^2 was mostly regarded as the cut-off value of WFmax in differentiation between DU and normal detrusor contractility which may result to those controversial findings about non-invasive parameters in previous researches. Recently, scholars have proposed that WFmax cut-off value between DU and normal detrusor contractility should be lowered to 7W/m^2 because more poor prognosis was detected in benign prostate hyperplasia (BPH) patients with WFmax <7W/m^2 compared to <10W/m^2 in following up after transurethral resection of prostate (TURP) (3,5). In this study, significant correlations between WFmax and PV, PVR, Qmax and BWT in male patients with BPH/BOO were found similar to these researches(9). It is worth noting that larger PVR, smaller PV, lower Qmax and thinner BWT were found if DU was defined as WFmax<7W/m^2 in this study, which suggested that those non-invasive parameters have a powerful capacity in differentiation of DU from normal detrusor contractility if the diagnosis criterion of DU was WFmax<7W/m^2.

Although various non-invasive parameters have been proven to have to some extent capacity in differential diagnosis of DU, it could not challenge ‘the golden standard’ of invasive PFS (10). Similar to this study, Tianjin Union Medical Center defined maximum detrusor pressure (Pdet.max) < 50cmH2O as the diagnostic criteria of DU, they found that PV (OR=0.976, P=0.002) and PVR (OR=1.004, P=0.004) were independent predictors of DU and the AUC of combination of PVR and PV (PV+PVR) was 0.774, the sensitivity of diagnosis for DU was 77.78%, and the specificity was 73.68%(11). Therefore, it was suggested that change in UDS definition of DU was likely to result to alter of the ability of non-invasive parameters in differentiation between DU and normal detrusor contractility. However, no consensus has been reached about UDS definition of DU across the world and more researches would be needed to find more appropriate UDS criterion to define DU in the future. However, this study still has those defects: ① The retrospective nature of this study weaken the robust of the conclusion derived from this study; ②



PVR: Post-void residual volume; PV: prostate volume; Qmax: Maximum flow rate ; BWT: Bladder wall thickness

Figure 1. Spearman correlation analysis between WFmax and PVR (A), PV (B), Qmax (C), and BWT (D)

Table 1. Results of single factor analysis of noninvasive urodynamic parameters

	Group A(n=99)	Group B(n=349)	*t/u*	*P*
age	71.83±8.49	70.62±7.86	1.32	0.187
PVR	134(80,250)	60（12,120）	6.85	<0.01
PV	53(31,75)	65(45,90)	3.65	<0.01
Qmax	5.2(3.2,7.4)	6.9(4.5,9.1)	4.34	<0.01
BWT	4(3,4.5)	4(3.3,5.0)	2.50	0.012

Group A: detrusor underactivity (WFmax＜7W/m2); Group B: detrusor contractility was acceptable (WFmax≥7W/m2);
PVR: Post-void residual volume; PV: prostate volume; Qmax: Maximum flow rate ; BWT: Bladder wall thickness

There was not a comparative test in the capacity of non-invasive parameters in differentiation of DU from normal detrusor contractility using different UDS criterion defined by WFmax in this study;③ Larger cohort studies were needed to validate our results. Summarily, male patients with DU had larger PVR, smaller PV, lower Qmax and thinner BWT compared with normal detrusor contractility when DU was defined as WFmax<7W/m^2.

Conflicts of Interest: All authors have no conflicts of interest to declare.

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