Original article

Videourodynamic analysis in men with lower urinary tract symptoms: Correlation between age and prostate size with lower urinary tract dysfunction

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ABSTRACT

Objectives: Lower urinary tract symptoms (LUTS) are highly prevalent in aging men. In this study we examined the relationship between age, total prostate volume (TPV), and videourodynamic study findings.

Methods: We retrospectively analyzed a total of 971 men ≥40 years of age referred to us for investigation of LUTS. We analyzed the distribution of the different videourodynamic study diagnoses in male LUTS by correlating their age and prostate size.

Results: The most common diagnosis in the bladder outlet obstruction (BOO) group differed significantly by age and poor relaxation of the external sphincter (PRES) in those aged <50 years; bladder neck dysfunction in those aged 50–69 years, and benign prostatic obstruction in those ≥60 years. Detrusor overactivity was the most common diagnosis in all ages in the bladder dysfunction group, and the cases of hyperactivity with impaired contractility (DHIC) increased with age. In patients <50 years of age, PRES was the most common diagnosis in the BOO group in both those with small prostates (total prostate volume <40 mL) and large prostates (total prostate volume ≥40 mL). In patients aged 50–69 years, the most common diagnosis in those with BOO and a small prostate was bladder neck dysfunction, and that in those with BOO and a large prostate was benign prostatic obstruction. Similar results were observed in patients aged ≥70 years. In all age groups, the majority of patients with detrusor overactivity, hypersensitive bladder, detrusor underactivity, and DHIC had a small prostate.

Conclusion: In male LUTS, the diagnoses in the BOO group differed by age and prostate volume. In young patients with BOO, the leading diagnosis was PRES, and the contribution of prostate volume to BOO increased with age. As age increased, the bladder function became more complex with an increased percentage of patients with DHIC. Both bladder outlet and bladder functions were affected by age.

1. Introduction

Lower urinary tract symptoms (LUTS) are among the most common and socially disruptive conditions encountered in urological practice worldwide. The overall prevalence of LUTS in men is 18.7%. The prevalence is lowest among men 30–39 years old (10.5%) and increases with age until a maximum in the 7th decade (26.5%). LUTS is an umbrella term that encompasses storage symptoms (frequency, urgency, nocturia, urge incontinence), voiding symptoms (dysuria, hesitancy, intermittency, slow stream, straining, terminal dribble), and post micturition symptoms (sensation of incomplete emptying, post micturition dribble). An estimated 10% of Taiwanese men older than 40 years have at least one bothersome LUTS.

In the past, the prostate was blamed for just about every urination issue in elderly men. However, recent statistics have shown that only 25–50% of men with benign prostatic hyperplasia (BPH) have LUTS, and only 50% of men who present with LUTS have urodynamically-proven bladder outlet obstruction (BOO) due to BPH or another urethral pathology.

It is now widely acknowledged that although prostate enlargement can lead to the onset of male LUTS, other vesicogenic factors including detrusor overactivity (DO), nocturnal polyuria, detrusor underactivity (DU), neurogenic bladder dysfunction,
urinary tract infection, prostatitis, urethral stricture, bladder tumor, and urolithiasis are also etiologies. Aging, obesity, glucose intolerance, and hypertension may also contribute to LUTS. Given the wide variety of pathogeneses, identifying the underlying causes of LUTS based on symptoms alone is often difficult and incorrect. Videourodynamics study (VUDS), however, is described as the gold standard investigation for patients with LUTS. It is a dynamic integration of urine flow, pressure changes, and imaging studies during the bladder filling and emptying phases, and provides objective information to form an accurate diagnosis and formulate a tailored treatment plan. In this retrospective study, we discuss the different pathophysiological underlying male LUTS and analyze the relationship between age, prostate size, and VUDS findings.

2. Patients and methods

We retrospectively reviewed men aged ≥ 40 years who had undergone a VUDS for investigation of LUTS at our institution between August 1997 and November 2012. This study was approved by the Institutional Review Board and the Ethics Committee of Buddhist Tzu Chi General Hospital, Hualien, Taiwan (IRB 104-15-B). The eligible 971 cases for analysis had no active urinary tract infection, interstitial cystitis, occult or overt neuropathy (including cerebrovascular accident, diabetes mellitus, multiple sclerosis, Parkinson's disease, spinal cord injury), previous transurethral surgery, or prostatectomy. The International Prostatic Symptom Score and Quality of Life index questionnaire was used to assess the severity of LUTS. A significant bothersome symptom was defined by a score greater than 3. All enrolled patients were required to have at least one storage symptom and one voiding symptom in conjunction with an International Prostatic Symptom Score ≥ 8 and a QoL index ≥ 3. Total prostate volume (TPV) was measured using transrectal ultrasound. Based on their clinical diagnoses, patients considered to have benign prostatic obstruction (BPO) were treated empirically with alpha-blockers, and those considered to have an overactive bladder were treated with antimuscarinic agents.

A VUDS was conducted in those with LUTS that persisted for at least 1 month after initial treatment. The VUDS was set up in accordance with the recommendations of the International Continence Society using C-arm fluoroscopy and performed solely by an experienced urologist. The maximum flow rate (Qmax), voiding detrusor pressure at Qmax (Pdet,Qmax), postvoiding residual volume, sphincter electromyography (EMG) activity, and voiding cystourethrography were documented for the diagnosis of lower urinary tract dysfunction. VUDS was repeated at least twice to obtain a reproducible pressure flow tracing. BPO, bladder neck dysfunction (BND), poor relaxation of the urethral sphincter (PRES), hypersensitive ladder (HSB), DO, DU, and detrusor hyperactivity with impaired contractility (DHIC) were diagnosed according to the VUDS findings.

BPO was characterized by a Pdet,Qmax ≥ 50 cm H₂O or an Abrams-Griffiths number (Pdet,Qmax-2Qmax) ≥ 40. In equivocal cases, the features of the bladder neck, prostatic urethra, and external sphincter on voiding cystourethrography aided in making a diagnosis of BOO. DO was defined as any involuntarily phasic detrusor contraction occurring during the filling phase, and HSB was defined as an early first sensation of bladder filling that occurred at low bladder volume (< 250 mL) and persisted. If sphincter EMG showed relaxed activity with an open membranous urethra during voiding, a low flow rate was considered to be due to DU. However, if the sphincter EMG showed nonrelaxed activity in association with a narrow membranous urethra during voiding, the low-flow rate was regarded as due to low detrusor contractility induced by PRES.

The results of the VUDS were further stratified into five age groups (40–49 years, 50–59 years, 60–69 years, 70–79 years, and ≥ 80 years) and four prostate size groups (< 30 mL, 31–40 mL, 41–60 mL, and ≥ 60 mL). The values of various clinical and urodynamical parameters among patients with and without BPO, and with and without DO, were expressed as mean ± standard deviation and compared with the t test. All statistical analyses were carried out with SPSS version 17 (SPSS Inc., Chicago, IL, USA).

3. Results

The mean age of these 971 patients was 72 ± 11 years (range, 40–98 years). There were 29 men with LUTS who were younger than 50 years, 117 patients in the 50–59 years age group, 215 patients in the 60–69 years age group, 351 men in the 70–79 years age group, and 259 patients older than 80 years. Age-stratified distribution of the VUDS findings is shown in Table 1.

The underlying pathophysiology in male LUTS could be divided into BOO (69.6% of patients) and bladder dysfunction (30.4%). The causes of BOO included BND in 243 patients (25.0%), BPO in 317 patients (32.6%), and PRES in 116 patients (11.9%). The diagnosis in those with bladder dysfunction was DO in 177 patients (18.2%), HSB in 25 patient (2.6%), DU in 38 patient (3.9%), and DHIC in 55 patient (5.7%; Figure 1). BOO was the most common cause of LUTS in all age groups, especially in the 70–79 years age group. The most prevalent age-related etiologies in the BOO group were PRES in the <40–49 years age group and BPO in those aged ≥ 50 years. On the contrary, in patients with bladder dysfunction, DO was the most common diagnosis in all age groups and along with DHIC, the incidence rose with age (Table 1).

We examined the VUDS diagnosis based on the TPV alone. Those with a TPV > 40 mL had a higher incidence of BOO due to BPO (TPV 41–60 mL 46.3%; TPV ≥ 61 mL 68.3%), whereas in those with a TPV < 40 mL, the incidence of BPO was lower (TPV 31–40 mL 20.5%; TPV ≤ 30 mL 17.5%; Table 2). BND was the most common VUDS finding in those with smaller prostates (<30 mL and

Table 1

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>BND (243)</th>
<th>BPO (317)</th>
<th>PRES (116)</th>
<th>Total</th>
<th>DO (177)</th>
<th>HSB (25)</th>
<th>DU (38)</th>
<th>DHIC (55)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–49</td>
<td>6 (26.1)</td>
<td>4 (17.4)</td>
<td>13 (56.5)</td>
<td>23</td>
<td>15 (53.6)</td>
<td>1 (16.7)</td>
<td>6 (21.4)</td>
<td>6 (21.4)</td>
<td>6 (26.1)</td>
</tr>
<tr>
<td>50–59</td>
<td>39 (43.8)</td>
<td>32 (36.0)</td>
<td>18 (20.2)</td>
<td>89</td>
<td>15 (31.6)</td>
<td>6 (25.0)</td>
<td>6 (25.0)</td>
<td>6 (25.0)</td>
<td>15 (31.6)</td>
</tr>
<tr>
<td>60–69</td>
<td>78 (46.2)</td>
<td>57 (33.7)</td>
<td>34 (20.1)</td>
<td>169</td>
<td>30 (55.2)</td>
<td>7 (12.3)</td>
<td>3 (5.5)</td>
<td>6 (11.5)</td>
<td>30 (55.2)</td>
</tr>
<tr>
<td>70–79</td>
<td>73 (29.9)</td>
<td>136 (55.7)</td>
<td>35 (14.3)</td>
<td>244</td>
<td>70 (55.4)</td>
<td>8 (7.5)</td>
<td>14 (10.2)</td>
<td>15 (10.2)</td>
<td>70 (55.4)</td>
</tr>
<tr>
<td>≥80</td>
<td>47 (31.1)</td>
<td>88 (58.3)</td>
<td>16 (10.6)</td>
<td>151</td>
<td>59 (58.6)</td>
<td>3 (2.8)</td>
<td>13 (12.0)</td>
<td>33 (30.6)</td>
<td>59 (58.6)</td>
</tr>
<tr>
<td>Total</td>
<td>243 (25)</td>
<td>317 (32.6)</td>
<td>116 (11.9)</td>
<td>676 (69.6)</td>
<td>177 (18.2)</td>
<td>25 (2.6)</td>
<td>38 (3.9)</td>
<td>55 (5.7)</td>
<td>295 (30.4%)</td>
</tr>
</tbody>
</table>

Data are presented as n (%).

BND = bladder neck dysfunction; BPO = benign prostatic obstruction; DHIC = detrusor hyperreflexia and inadequate contractility; DO = detrusor overactivity; DU = detrusor underactivity; HSB = hypersensitive bladder; PRES = poor relaxation of external sphincter.
31–40 mL) whereas BPO became the predominant feature in patients with prostates > 40 mL. DO was highly prevalent in almost all prostate size groups, especially in those with prostates ≥ 60 mL.

Figures 2 and 3 compare the incidence of BOO and bladder dysfunction in patients in different age groups and prostate volume groups, respectively. The rate ratio of bladder dysfunction to BOO increased with increasing age (0.287 in the 40–49 years group vs. 0.802 in the ≥ 80 years group; Figure 2). However, the rate ratio of BOO to bladder dysfunction increased with increasing TPV (1.673 in the TPV ≤ 30 mL group vs. 5.949 in the TPV > 60 mL group; Figure 3).

By correlating both age and TPV, we found that in patients younger than 50 years, PRES was the most common diagnosis in the BOO group in both the small prostate (TPV ≤ 40 mL) group and large prostate (TPV > 40 mL) group. In the 50–69 years age group, the most common diagnosis in those with BOO and a small prostate was BND, and that in those with BOO and large prostate was BPO. Similar results were observed in patients older than 70 years. In all age groups, the majority of patients with DO, HSB, DU, and DHIC had a small prostate (Figure 4).

Table 3 compares the clinical characteristics and urodynamic parameters in patients with BOO and DO, BOO without DO, and DO without BOO. The presenting symptoms (both storage and empty) were not significantly different among patients with and without BOO in the presence of DO. Nevertheless, men with BOO or DO had a significantly earlier first sensation of filling, greater voiding pressure, lower Qmax, and smaller bladder capacity than those without BOO or DO.

Table 2

<table>
<thead>
<tr>
<th>TPV</th>
<th>BND (243)</th>
<th>BPO (317)</th>
<th>PRES (116)</th>
<th>Total (676)</th>
<th>DO (177)</th>
<th>HSB (25)</th>
<th>DU (38)</th>
<th>DHIC (55)</th>
<th>Total (295)</th>
<th>DO (%)</th>
<th>HSB (%)</th>
<th>DU (%)</th>
<th>DHIC (%)</th>
<th>Total (%)</th>
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<tr>
<td>≤30</td>
<td>114 (42.5)</td>
<td>75 (28.0)</td>
<td>79 (29.5)</td>
<td>268</td>
<td>98 (61.3)</td>
<td>17 (10.6)</td>
<td>17 (10.6)</td>
<td>28 (17.5)</td>
<td>160</td>
<td>428</td>
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<tr>
<td>31–40</td>
<td>59 (51.8)</td>
<td>36 (31.6)</td>
<td>19 (16.7)</td>
<td>114</td>
<td>41 (66.1)</td>
<td>5 (8.1)</td>
<td>8 (12.9)</td>
<td>8 (12.9)</td>
<td>62</td>
<td>176</td>
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<tr>
<td>41–60</td>
<td>50 (32.5)</td>
<td>94 (61.0)</td>
<td>10 (6.5)</td>
<td>154</td>
<td>32 (65.3)</td>
<td>2 (4.1)</td>
<td>5 (10.2)</td>
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<td>49</td>
<td>203</td>
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<tr>
<td>≥61</td>
<td>20 (14.3)</td>
<td>112 (80.0)</td>
<td>8 (5.7)</td>
<td>140</td>
<td>6 (25.0)</td>
<td>1 (4.2)</td>
<td>8 (33.3)</td>
<td>9 (37.5)</td>
<td>24</td>
<td>164</td>
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</table>

Data are presented as n (%).

BND = bladder neck dysfunction; BPO = benign prostatic obstruction; DHIC = detrusor hyperreflexia and inadequate contractility; DO = detrusor overactivity; DU = detrusor underactivity; HSB = hypersensitive bladder; PRES = poor relaxation of external sphincter; TPV = total prostatic volume.
and BPO secondary to BPH is commonly seen in advanced age groups.19 By contrast, we reported PRES and BND were more likely responsible for LUTS in men younger than 50 years. This result was similar to what Wang et al.17 published in 2003, which stated nonrelaxing external urethral sphincter and primary neck obstruction were common causes in young population with small prostates (< 30 mL). It may be contributed by the dysfunction of complex sympathetic nervous system.

The prostate enlarges with age and its volume has been associated with LUTS progression.18 Our results indicated that a TPV of < 40 mL in patients younger than 60 years had relatively little effect on their BOO. The volume of the prostate played a more vital role in BND and BPO in older age groups. On further evaluation, we demonstrated that cases of DO and DHIC increased in the elderly. In addition, men with BPO or DO had a significantly earlier first sensation of filling, greater voiding pressure, lower Qmax, and smaller bladder capacity than men without those conditions. This may imply the fact that complexity of bladder function is affected by age and probably secondary to BOO, especially in those with chronic symptoms.

We also showed that presenting symptoms (both storage and empty) were not significantly different among patients with and without BPO in the presence of DO. As concluded in a systematic review, symptoms alone are not enough to adequately diagnose BOO.13 The accurate diagnosis of LUTS should be determined by findings from a combination of a comprehensive history, physical examination, and urodynamic study. Hence, unnecessary surgery can be avoided when suitable medical treatment is available and the success rate of surgery can be optimized in those who need it.

5. Conclusion

In male LUTS, the diagnosis in the BOO group differed by age and prostate volume. The leading diagnosis in young patients with BOO was PRES, and the contribution of TPV to BOO increased with age. As age increased, bladder function became more complex with an increased percentage of DHIC. Both bladder outlet and bladder functions were affected by age.

Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

Sources of funding

No funding was received for the work described in this article.

Table 3

<table>
<thead>
<tr>
<th>TPV&lt;40</th>
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Figure 4. The effects of age (x-axis) and total prostatic volume (mL) on lower urinary tract dysfunction in men with lower urinary tract symptoms. BND – bladder neck dysfunction; BPO – benign prostatic obstruction; DHIC – detrusor hyperreflexia with impaired contractility; DO – detrusor overactivity; DU – detrusor underactivity; HSB – hypersensitive bladder; PRES – poor relaxation of external sphincter; TPV – total prostatic volume.

References