Hypersensitive or Detrusor Overactivity: Which is Associated with Filling Symptoms in Female Bladder Outlet Obstructed Patients?

Junlong Zhang¹, Mingxin Cao¹, Yu Chen¹, Weijie Liang¹, Yueyou Liang¹*

Purpose: To investigate and compare detrusor overactivity (DO) and bladder filling sensation characteristics in female bladder outlet obstruction (FBOO) patients with or without overactive bladder (OAB) symptoms.

Materials and Methods: One hundred fifty-seven FBOO patients with urodynamic testing were recruited. Patients who showed urinary urgency (≥6 episodes/3 d), with or without urinary frequency (≥8 voids/24 h), and urge incontinence (≥3 episodes/3 d) were considered to have OAB. The detrusor overactivity (DO) and bladder filling sensation measures including first sensation (FSF), first desire to void (FDV) and strong desire to void (SDV) during filling cystometry were recorded. The associations between urodynamic variables and OAB symptoms were analysed.

Result: FBOO patients had a high incidence (79%) of OAB. FBOO patients with OAB symptoms had significantly younger age, higher incidence of DO (19.4% versus 6.1%)(P < .051) and lower bladder volumes at FSF (180.32 ± 83.48 versus 226.18 ± 100.90 mL), FDV (269.00 ± 109.78 versus 330.45 ± 123.95 mL) and SDV (345.56 ± 135.43 versus 422.33 ± 148.40 mL)(P < .05) compared to patients without OAB. In multivariate analyses, both DO (OR = 4.83, 95% CI: 1.02-22.85, P = .047) and lower bladder volumes at FDV (OR = 2.47, 95% CI: 1.03-5.95, P = .044) and SDV (OR = 3.07, 95% CI: 1.25-7.55, P < .014) were still independently associated with OAB, after adjustment for age and other confounding factors.

Conclusion: FBOO patients had a high incidence of OAB. Not only DO but also bladder hypersensitivity were independently associated with OAB symptoms in FBOO patients.

Keywords: hypersensitivity; urinary bladder neck obstruction; urinary bladder, overactive; urodynamics; urinary Incontinence, urge

INTRODUCTION

Female bladder outlet obstruction (FBOO) is a relatively uncommon condition in clinical practice¹⁻⁴. Overactive bladder (OAB) symptoms, including urgency, frequency and nocturia, are quite common among female patients, especially in patients with bladder outlet obstruction, which severely affect women’s life quality⁵⁻⁶. The reported incidence of OAB among bladder outlet obstruction patients was around 50-75%⁷. OAB symptoms can be induced either by obstruction or the secondary effects of obstruction on the bladder⁸. Whereas, to date, the underlying mechanisms of OAB symptoms in FBOO patients remains the subject of debate and the anticholinergic drugs have many side effects⁹. A more thorough investigation of its pathophysiological mechanisms will be helpful in further investigations of therapeutic drugs.

Detrusor overactivity (DO), characterized by involuntary detrusor contractions during the filling phase in urodynamic test, is a known cause for OAB symptoms¹⁰. However, the antimuscarinic therapy based on this mechanism shows limited efficiency in clinical practice¹¹. Urologist and clinical researchers have now placed a new focus on the effect of increasing bladder sensation on OAB symptoms. A few studies have found that OAB patients had lower micturition and decreased bladder volumes, which suggested that bladder hypersensitivity contributes to the development of OAB¹²⁻¹³. However, the association between bladder filling sensation and OAB symptoms was still not adequately investigated in FBOO patients. The objective of this study was to examine the urodynamic parameters associated with OAB symptoms in FBOO patients.

MATERIAL AND METHODS

Study design and participants

This study was an observational study approved by the Institutional Review Board of the First Affiliated Hospital of Sun Yat-Sen University. The study was conducted according to the principles expressed in the Declaration of Helsinki. We screened female patients who referred for evaluation of lower urinary tract symptoms (LUTS) and underwent urodynamic testing in the first affiliated hospital of Sun Yat-sen university from 2008 to 2016. Patients with clinical dysuria symptoms and having the maximum flow rate (Qmax) ≤ 15 ml/s and detrusor pressure at the maximum flow (Pdet. Qmax) ≥ 20 cmH2O in urodynamic testing were eligible for

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Table 1. Comparisons of clinical and urodynamic parameters in FBOO patients with OAB and non-OAB symptoms.

<table>
<thead>
<tr>
<th>Clinical/Urodynamic Parameters</th>
<th>All-FBOO (N = 157)</th>
<th>OAB-FBOO (N = 124)</th>
<th>Non-OAB-FBOO (N = 33)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>46.80 ± 14.45</td>
<td>45.44 ± 13.88</td>
<td>51.94 ± 13.71</td>
<td>.010</td>
</tr>
<tr>
<td>Free Qmax, ml/s</td>
<td>11.29 ± 4.91</td>
<td>11.11 ± 4.61</td>
<td>11.99 ± 5.91</td>
<td>.473</td>
</tr>
<tr>
<td>Qmax, ml/s</td>
<td>7.38 ± 3.43</td>
<td>8.15 ± 3.41</td>
<td>6.86 ± 3.37</td>
<td>.103</td>
</tr>
<tr>
<td>Pdet Qmax, cmH2O</td>
<td>49.74 ± 30.32</td>
<td>51.46 ± 89.73</td>
<td>43.28 ± 21.15</td>
<td>.838</td>
</tr>
<tr>
<td>Pdet max, cmH2O</td>
<td>49.74 ± 32.02</td>
<td>49.50 ± 23.40</td>
<td>50.63 ± 21.86</td>
<td>.687</td>
</tr>
<tr>
<td>PVR, ml</td>
<td>87.54 ± 126.60</td>
<td>74.60 ± 109.19</td>
<td>133.42 ± 171.36</td>
<td>.064</td>
</tr>
<tr>
<td>DO</td>
<td>26(16.6%)</td>
<td>24 (19.4%)</td>
<td>2 (6.1%)</td>
<td>.051</td>
</tr>
<tr>
<td>FSF, mL</td>
<td>189.96 ± 89.07</td>
<td>180.32 ± 83.48</td>
<td>226.18 ± 100.90</td>
<td>.011</td>
</tr>
<tr>
<td>FDV, mL</td>
<td>281.92 ± 115.28</td>
<td>269.00 ± 109.78</td>
<td>330.45 ± 123.95</td>
<td>.009</td>
</tr>
<tr>
<td>SDV, mL</td>
<td>361.70 ± 141.29</td>
<td>345.56 ± 135.43</td>
<td>422.33 ± 148.40</td>
<td>.006</td>
</tr>
<tr>
<td>Blaivas-Groutz</td>
<td>1 (1-2)</td>
<td>1 (1-2)</td>
<td>.875</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: FBOO, female bladder outlet obstruction; OAB, overactive bladder; Free Qmax, the maximum free-flow rate; Qmax, the maximum flow rate; Pdet Qmax, detrusor pressure at maximum flow; Pdet max, maximum detrusor pressure; PVR, post-void residual urine; DO, detrusor overactivity; FSF, first sensation of bladder filling; FDV, first desire to void; SDV, strong desire to void.

Data were showed as means ± SD, numbers (%) or medians (interquartile range). P value for comparison between OAB-FBOO patients and Non-OAB-FBOO patients.

RESULTS

Among 2600 female patients undergoing urodynamic studies, 157 patients were recruited as FBOO, suggesting the prevalence of BOO was approximately 6%. The mean age was 46 ± 14 years old. The incidence of DO among FBOO patients was around 16.6%. Detailed urodynamic characteristics of FBOO are listed in Table 1. According to Blaivas-Groutz Nomogram, 116 (73.9%) FBOO patients were mild obstruction, and 36 (22.9%) were moderate obstruction and 5 (3.2%) were severe obstruction. The severe/moderate obstruction group showed a higher incidence of DO (29.3%) compared with the mild obstruction group (12.1%). Nevertheless, all bladder volume measures were not significantly different between groups with severe/moderate obstruction and mild obstruction.

Among the FBOO patients, 124 (79.0%) had OAB. As shown in Table 2, patients with OAB had a higher incidence of DO than patients without OAB (19.4% versus 6.1%, p = .051). FBOO patients with OAB had significantly lower FSF, FDV and SDV than those without OAB (Table 1). Patients with OAB seems to be younger than those without OAB. After adjusting for age and PVR, DO, FDV and SDV were still independently associated with the occurrence of OAB, and FSF tended to independently associate with OAB symptoms.
One typical urodynamic report of complicated FBOO shows high Pdetmax and low Qmax with DO and hypersensitivity.

**DISCUSSION**

In this cross-sectional study, we observe that both DO and low bladder volumes were correlated with OAB symptoms. Such results may indicate that not only DO but also increased bladder sensitivity could be the underlying pathophysiological mechanisms for OAB symptoms in FBOO patients. Compared with male BOO, FBOO is a relatively uncommon condition in clinical practice. The reported prevalence of BOO in female population varies widely from 2.7% to 23% in different studies because of various diagnostic criteria. In our study, a combined criteria of Qmax ≤ 15 ml/s and Pdet Qmax ≥ 20 cm H2O was used to define BOO, which had a sensitivity of 74.3% and a specificity of 91.1% to predict obstruction. Such criteria is thought to have good concordance with clinically diagnosed obstructions.

The incidence of OAB in FBOO patients in our study was similar to the data in the male population (60-70%). After adjusting for age and other confounding factors, the higher DO rates was still independently associated with OAB symptoms in FBOO patients. The high incidence of OAB symptoms with low incidence of DO in FBOO patients was consistent with a previous study, which also demonstrated that only 54% of women with DO had DO on urodynamic test, and 27% of the women with a diagnosis of DO on urodynamic test had OAB symptoms. The inconsistence between OAB and DO rates suggests that other pathophysiological mechanisms might be responsible for OAB symptoms in FBOO patients.

Some researchers have placed focus on identifying the associations between bladder sensations and OAB. Several studies reported that OAB patients not only had a higher incidence of DO but also revealed lower bladder volumes of FSF, FDV and SDV compared with non-OAB patients, suggesting hypersensitive bladder in OAB patients. In our study, we adopted urodynamic variables during filling cystometry as an objective method to record bladder sensations, which has been demonstrated to have good correlations with sensory questionnaire scores in a prior study. We found that the bladder volumes were lower in FBOO patients with OAB symptoms than those without OAB symptoms. Thus, this study suggested that FBOO could induce lower bladder volumes which may be related to OAB symptoms in these patients.

The mechanisms of OAB symptoms in BOO patients remain a matter of debate, with neurogenic mechanism classified as one of the leading causes. In the experimental studies, various neurochemical, such as nitric oxide synthase and NADPH-diaphorase, have been shown to change in afferent pathways of the animal model of bladder outlet obstruction. Additionally, short latency micturition reflex was found in urethral obstructed rats. These changes in reflex pathways were considered as neuronal plasticity, which indicated that the nerves were influenced by the pathological processes in target organs. Recently, there are increasing interest in the investigation of afferent system (sensory innervation as an important therapeutic target for lower urinary tract symptoms. Our study might further support the neurogenic mechanisms and the importance of investigations on therapies directed at the afferent system in FBOO patients with OAB symptoms. This study had several limitations. First, there was no general agreement on the urodynamic parameters for defining FBOO. We used the criteria of Qmax ≤ 15 ml/s and Pdet Qmax ≥ 20 cm H2O in this study, which is thought to have high concordance with clinically diagnosed obstructions. Second, this was a cross-sectional study, which could not support the cause and effect associations between DO, bladder hypersensitivity and OAB in FBOO patients. Further longitudinal, prospective, and large-scale studies are warranted to validate these findings.

**CONCLUSIONS**

FBOO patients had a high incidence of OAB symptoms. Both urodynamic DO and bladder volumes in filling cystometry tests were independently associated with the occurrence of OAB symptoms in FBOO patients, suggesting that not only DO but also increased bladder sensitivity may be pathophysiological mechanisms underlying this symptomatology.

**ACKNOWLEDGEMENT**

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**CONFLICT OF INTEREST**

The authors declare that they have no competing interests.

**REFERENCES**


