Practical urodynamics

Detrusor contractility prior to and after surgery of acquired bladder diverticula

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1. Introduction

Bladder diverticula are classified as either congenital or acquired. Acquired diverticula frequently occur in men with bladder outlet obstruction (BOO) due to benign prostatic hypertrophy (BPH). The development of moderate- to large-sized bladder diverticula is reported in 1–6% of male patients with lower urinary tract symptoms (LUTS). Bladder diverticula do not cause specific symptoms and are often found during evaluation for LUTS. Urodynamic evaluation for BOO and detrusor contractility is useful in choosing the treatment for bladder diverticula.1 However, urodynamic studies of bladder function prior to and after treatment of bladder diverticula have seldom been reported.

We herein report the case of an LUTS patient who presented with three relatively large bladder diverticula. The patient underwent transurethral resection of the prostate (TUR-P), followed by diverticulectomy as a second procedure. Urodynamic evaluation for BOO and detrusor contractility was useful in choosing the treatment for bladder diverticula.1 However, urodynamic studies of bladder function prior to and after treatment of bladder diverticula have seldom been reported.

2. Case report

A 75-year-old man was evaluated for increasing difficulty with urination. Voiding cystourethrography (VCUG) showed three diverticula measuring 3 cm, 5 cm, and 6 cm in diameter (Fig. 1A). A pressure-flow study using Schäfer’s nomogram showed that detrusor contractility was normal. There was severe BOO (Grade V; Fig. 2).

The patient underwent a TUR-P. Assessment of LUTS 1 month after the surgery that showed a markedly improved IPSS and improved quality of life (QOL) score (Fig. 3). Objective assessment revealed no change in residual urine volume, but uroflowmetry showed an improvement in the maximum flow rate ($Q_{\text{max}}$; Fig. 4).

In addition, a pressure-flow study using Schäfer’s nomogram showed that detrusor contractility was normal, and the BOO was almost completely resolved (Grade I; Fig. 2).

However, the patient complained of double voiding, which was thought to be due to the diverticula, and therefore, 2 months after the TUR-P, diverticulectomy was performed by a combined intravesical/extra-vesical approach. Evaluation 6 months after diverticulectomy showed that the IPSS and QOL score were similar to the preoperative scores, the double voiding had resolved, and the patient was satisfied (Fig. 3).

An objective assessment also revealed a reduction in the residual urine volume, and uroflowmetry showed a further improvement in $Q_{\text{max}}$. However, the uroflowmetry curve suggested abdominal straining (Fig. 4). A pressure-flow study using Schäfer’s nomogram again showed that detrusor contractility was normal. Obstruction was Grade I, the same as after the TUR-P (Fig. 2).

However, on review of the actual pressure curve from the pressure-flow study, the $Q_{\text{max}}$ (arrow) used on the normogram was obtained by abdominal straining (Fig. 1).

Therefore, to evaluate the detrusor contractility accurately, the $Q_{\text{max}}$ (arrowhead) without abdominal straining was reassessed (Fig. 1), and Schäfer’s nomogram showed weak detrusor contractility after diverticulectomy (Fig. 2). The VCUG after diverticulectomy also showed a deformity of the bladder (Fig. 1B).

3. Discussion

The influence of bladder diverticula on assessment of BOO and detrusor contractility by pressure-flow analysis has seldom been previously reported. It is conceivable that detrusor contractility may appear to be diminished on urodynamics due to the “pressure...
sink effect of bladder diverticula. However, the present pressure-flow study results prior to and after TUR-P demonstrate that BOO and detrusor contractility can be fully evaluated even when many bladder diverticula are present.

Similarly, Adot Zurbano et al reported that detrusor contractility measurements were not significantly different between BPH patients with and without diverticula. They also showed that bladder diverticulectomy did not injure detrusor contractility at 3 months after surgery. By contrast, the present results showed a weakening of detrusor contractility after bladder diverticulectomy at 6 months after surgery.

Fig. 1. Pressure-flow study and voiding cystourethrography (A) post-TUR-P and (B) postdiverticulectomy. (A) Pressure-flow study shows a voiding pattern without abdominal straining after TUR-P. Voiding cystourethrography indicates that postvoiding residual urine is not from the bladder but from the diverticula. (B) The automatically processed $Q_{\text{max}}$ is 15 mL/s, but this value was obtained by abdominal straining (arrow). The real $Q_{\text{max}}$ caused by detrusor contraction is 8 mL/s after diverticulectomy (arrowhead). $P_{\text{abd}}$ = abdominal pressure; $P_{\text{det}}$ = detrusor pressure; $P_{\text{ves}}$ = vesical pressure; $Q_{\text{ura}}$ = urethra flow rate; TUR-P = transurethral resection of the prostate; $V_{\text{ures}}$ = voided volume.

Fig. 2. $P_{\text{det}}$ values at $Q_{\text{max}}$ (a) pre-TUR-P, (b) post-TUR-P, and (c and d) post-diverticulectomy have been plotted from data obtained by the pressure-flow study on Schäfer’s nomogram. The automatically processed postdiverticulectomy value shown in (c) is incorrect, because $Q_{\text{max}}$ was obtained by abdominal straining. The values of $P_{\text{det}}$ at $Q_{\text{max}}$ show the release of BOO after TUR-P and the decrease in detrusor contractility after diverticulectomy. Roman numbers indicate the degree of obstruction, and bladder contractility is divided into ST (strong), N (normal), W (weak), and VW (very weak). BOO = bladder outlet obstruction; TUR-P = transurethral resection of the prostate.

Fig. 3. IPSS and QOL scores prior to and after treatment. The circles indicate IPSS, and the squares indicate QOL scores. Both IPSS and QOL scores improve markedly after TUR-P, and the improvements continue after diverticulectomy. IPSS = International Prostate Symptom Score; QOL = quality of life; TUR-P = transurethral resection of the prostate.
The difference in results for detrusor contractility between the present study and that of Adot Zurbano et al\(^3\) may be due to the number of bladder diverticula. In their study, although the size was unknown, there was only a single bladder diverticulum, as compared with three relatively large diverticula in the present patient. Extensive dissection around the bladder, as well as cystotomy and suture, damages to bladder blood flow, peripheral nerve, and detrusor muscle may have decreased detrusor contractility. Another possible explanation for the decreased detrusor contractility is the different voided volume because \(Q_{\text{max}}\) is known to depend on the voided volume.\(^4\) However, there was little difference in voided volume when pressure-flow studies were performed at post-TUR-P and postdiverticulectomy. Therefore, it is unlikely that voided volume affects the comparison of detrusor contractility in this case.

Caution is necessary when assessing nomograms from pressure-flow studies that are automatically interpreted by computer. For accurate evaluation of BOO and detrusor contractility using Schäfer’s nomogram in BPH patients, it is assumed that voiding is without abdominal straining.\(^4,5\) If the \(Q_{\text{max}}\) is obtained with abdominal straining, then as in the results after diverticulectomy in the present case, accurate assessment from the actual curves and flow curves is necessary.

In conclusion, evaluation of BOO and detrusor contractility by pressure-flow studies is useful even when bladder diverticula are present. However, caution is necessary, because diverticulectomy in patients with multiple bladder diverticula may cause bladder contractile dysfunction. When pressure-flow studies are performed in BPH patients with bladder diverticula and there is abdominal straining, accurate assessment from the actual curves, rather than from the automatically interpreted nomograms, is necessary.

**Conflicts of interest statement**

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.

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**Appendix A. Supplementary data**

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.urols.2013.11.004.

**References**