

COMPENSATORY DETRUSOR RESPONSES MANIFESTED BY MAINTENANCE OF FUNCTIONAL DETRUSOR RESERVE IN ADULT MEN WITH BLADDER OUTLET OBSTRUCTION

Aims of Study

The contractile strength of the bladder depends on the functional integrity of the detrusor muscle and its motor innervation. Previous human and animal studies have shown that isovolumetric detrusor pressure (P_{isv}) and maximum watts factor (WF) increase with bladder outlet obstruction (BOO), suggesting a compensatory detrusor response to chronic obstruction. However, in some patients, voiding efficiency is impaired despite elevation of these contractility parameters. We propose that the increase in P_{isv} or WF must be commensurate with the biomechanical response of the detrusor to increasing outlet resistance to maintain a balanced bladder. Failure to respond adequately to this outlet challenge results in abnormal residual volumes and may reflect impaired detrusor contractility relative to the severity of obstruction. Thus, the relationship between the ability of the detrusor to contract against a completely occluded outlet and the pressure generated during flow represents the degree of functional detrusor reserve (DR). This concept may provide a better assessment of compensated detrusor function. To test this concept, we studied the relationships between detrusor reserve and BOO, post-void residual volume and voiding efficiency.

Methods

Comprehensive videourodynamic studies were performed in adult men with lower urinary tract symptoms. Patients with spinal cord injury, Parkinson's disease or stroke were excluded from analysis. Medium fill cystometry was performed to determine bladder capacity and assess bladder activity. The presence of BOO was detected by voiding profilometry as described previously. The maximum P_{isv} was measured during a bladder contraction against a completely occluded bladder neck. Voiding efficiency (VE) was determined from the ratio of voided volume to bladder capacity expressed as a percentage. Detrusor reserve (DR) was calculated as the difference between P_{isv} and maximum voiding pressure (P_{detmax}) during steady flow.

To determine the relationships among various urodynamic parameters, patients were separated into 2 groups based on their VE or DR. Poor VE was defined as $VE < 80\%$, $PVR > 100\text{ml}$ was considered high post void residual, and diminished detrusor reserve was defined as $DR < 20\text{ cmH}_2\text{O}$. These values were selected based on urodynamically normal subjects studied previously.

Patients were then categorized into the following four groups based on urodynamic diagnosis to determine the impact of voiding dysfunction on detrusor contractility: non-obstructed without detrusor overactivity (DO); DO alone; BOO; BOO with DO.

Results

Urodynamic studies from 235 patients were analyzed. The age and AUASI of the patients in this cohort were 68.9 ± 9.1 years and 15.6 ± 7.0 , respectively (mean \pm standard deviation).

Relationships between P_{isv} , DR, VE, and PVR. P_{isv} was not significantly correlated with either VE ($r = 0.003$, $p=0.96$) or PVR ($r = 0.058$, $p=0.37$), suggesting that P_{isv} alone does not adequately reflect the contractile ability of the bladder.

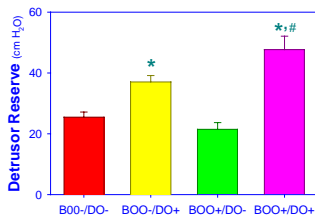
Patients with high post void residual volumes ($PVR > 100\text{ml}$) or poor voiding efficiency ($VE < 80\%$) had a significantly lower DR than patients with low PVR or high VE. Similarly, patients with diminished DR ($DR < 20\text{ cm H}_2\text{O}$) had a significantly higher PVR and lower VE than patients with normal DR.

Detrusor reserve in 4 diagnostic groups. DO was present in 26% ($n = 60$) of the patients, BOO in 27% ($n = 63$), BOO with DO was present in 17% ($n=40$), while 29% of the patients ($n = 69$) had neither BOO nor DO.

VE was significantly lower in the obstructed group without DO (BOO+/DO-) compared to both groups with DO (BOO-/DO+, BOO+/DO+). Furthermore, PVR was higher in obstructed patients without DO (BOO+/DO-) than in any other group. P_{detmax} was significantly higher in the obstructed groups (BOO+/DO-, BOO+/DO+) compared with the non-obstructed groups (BOO-/DO-, BOO-/DO+), but not different between non-obstructed

groups. Differences in P_{isv} were significant among all groups. P_{isv} was significantly higher in patients with DO, with or without BOO, compared to those without DO; also, BOO with or without DO was associated with higher P_{isv} compared to non-obstructed groups. However, the greater P_{isv} in the BOO+/DO- group, presumed to be a characteristic of increased bladder contractility, is inconsistent with the elevated PVR and decreased VE in this group. Despite the significantly higher P_{isv} in patients with BOO compared to those without obstruction, DR was similar in obstructed and non-obstructed patients (see figure). However, DR was significantly higher in patients with DO (BOO+/DO+, BOO-/DO+) compared to those without DO (BOO-/DO-, BOO+/DO-). In patients with BOO, DR was significantly higher in patients with obstruction compared to those without obstruction.

In the 2 obstructed groups (with or without DO), the proportion of patients with impaired voiding efficiency (<80%) was significantly higher in patients without DO (76.2%) than those with DO (42.5%). Furthermore, the presence of DO was associated with a significantly higher DR in obstructed patients with either impaired or normal VE. In the obstructed group without DO, the DR was significantly higher in patients with normal VE compared to those with impaired VE.



Conclusions

Our study in adult men with BOO suggests that the effectiveness of the compensatory detrusor response can be assessed by DR. During the compensatory phase of BOO, DR is maintained and thus PVR remains low. However, a reduction in DR may result in large residual volumes, despite an increase in P_{isv} or WF. Thus, DR may indicate the degree of bladder compensation or decompensation in patients with symptomatic voiding dysfunction and may predict those patients at risk of urinary retention. In addition, this study demonstrated that the presence of DO may contribute to the effectiveness of compensation.