

## DIAGNOSTIC VALUES OF NON-INVASIVE TESTS FOR EVALUATION OF BLADDER OUTLET OBSTRUCTION IN PATIENTS WITH BENIGN PROSTATIC HYPERPLASIA

### Hypothesis / aims of study

Benign prostatic hyperplasia (BPH) is one of the most common benign diseases in men that can lead to benign prostatic enlargement (BPE), bladder outlet obstruction (BOO) and/or lower urinary tract symptoms (LUTS). No clear correlations between LUTS, BPE and BOO have been found so far. Therefore, each parameter of this disease has to be evaluated separately in patients with BPH. Detection and quantification of the prostate size by digitorectal examination or (transrectal) ultrasound measurement, and LUTS by history or IPSS-questionnaire are quick and simple. However, evaluation of BOO is more difficult. Until now, only pressure-flow analyses of urodynamic investigations are able to determine BOO accurately. However, urodynamic investigations are invasive, expensive and time consuming. In clinical routine, measurements of postvoid residual urine and prostatic volume as well as free uroflowmetry are used to predict BOO in men with BPH. Studies with experimental animals revealed a significant enlargement of the bladder wall as well as increase of bladder weight after induction of artificial obstruction. Based on these experimental data, clinical studies confirmed these findings in humans with BOO due to BPH [1]. With ultrasound technique it has been possible to visualize detrusor wall thickening in men with BOO [2]. The aim of our study was to determine the diagnostic values and accuracy of all non-invasive tests which pretend to predict BOO.

### Study design, materials and methods

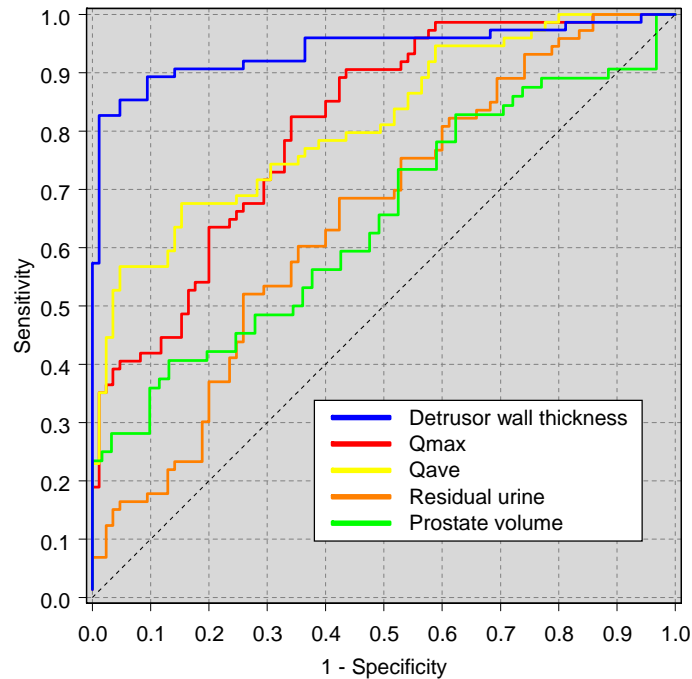
Men with LUTS and/or prostatic enlargement all suspicious of BOO due to BPH were recruited from the outpatient department from the beginning of 2000 until the end of 2001. The study was conducted according to the regulations of the local ethical committee. 160 men aged between 40 - 89 years (mean: 63 years) participated in this study. The following tests were performed in all men: measurements of prostatic volume with a 7.5 MHz transrectal ultrasound probe (TRUS), free uroflowmetry ( $Q_{max}$ ,  $Q_{ave}$ ), postvoid residual urine with a 3.5 MHz curved array as well as detrusor wall thickness at the anterior bladder wall of a bladder filled >50% of bladder capacity with a 7.5 MHz linear array (all measurements with Philips SonoDiagnost360). Afterwards, BOO was determined by urodynamic investigations (pressure-flow). Parameters of obstructive and non-obstructive patients were analyzed with the T-Test. Sensitivity, specificity, negative and positive predictive values were calculated for  $Q_{max}$ ,  $Q_{ave}$ , residual urine, prostate volume and detrusor wall thickness. Receiver operator characteristic (ROC) curves and calculation of the area under the curve (AUC) were used to determine the diagnostic accuracy of these non-invasive tests in order to predict BOO.

### Results

In pressure-flow-analysis, 85 patients (53%) were non-obstructive and 75 patients (47%) were obstructive. All investigated parameters were significantly different between non-obstructed and obstructed patients:  $Q_{max}$  ( $14.2 \pm 6.7$  vs.  $8.1 \pm 3.5$  ml/s,  $p < 0.001$ ),  $Q_{ave}$  ( $7.5 \pm 3.8$  vs.  $4.2 \pm 1.9$  ml/s,  $p < 0.001$ ), postvoid residual urine ( $116 \pm 115$  vs.  $185 \pm 163$  ml,  $p = 0.03$ ), prostate volume ( $33.4 \pm 12.1$  vs.  $46.5 \pm 26.8$  ml,  $p = 0.01$ ), and detrusor wall thickness ( $1.46 \pm 0.28$  vs.  $2.46 \pm 0.97$  mm,  $p < 0.001$ ). The diagnostic values of the tests are listed in the table:

	<b>non-obstructive/ obstructive</b>	<b>positive predictive value [%]</b>	<b>negative predictive value [%]</b>	<b>sensitivity [%]</b>	<b>specificity [%]</b>
<b><math>Q_{max}</math></b>	$\geq 15$ / $< 15$ ml/s	59	94.6	97.3	41.2
<b><math>Q_{ave}</math></b>	$\geq 7$ / $< 7$ ml/s	57.4	81.8	89.2	42.4
<b>Residual urine</b>	$\leq 50$ / $> 50$ ml	52.8	67.3	76.7	41.2
<b>Prostate volume</b>	$< 25$ / $\geq 25$ ml	55.6	65.4	85.9	27.9
<b>Detrusor thickness</b>	$< 2$ / $\geq 2$ mm	93.9	86.2	82.7	95.3

The AUC of ROC-analysis (figure) showed that the measurement of detrusor wall thickness was the most precise test to predict BOO (AUC 0.93). In contrast to this, measurements of  $Q_{max}$  (AUC 0.81),  $Q_{ave}$  (AUC 0.81), postvoid residual urine (AUC 0.64) and prostate volume (AUC 0.63) were less precise to predict BOO.



#### Interpretation of results

Of all non-invasive tests for determination of BOO in patients with BPH, the measurement of detrusor wall thickness is the best parameter to predict BOO. A detrusor wall thickness of 2 mm or more at a bladder filling of more than 50% of bladder capacity can predict BOO with a probability of 93.9%. All other tests are less accurate in predicting BOO.

#### Concluding message

Measurements of detrusor wall thickness should be used in clinical routine to clarify BOO in all men with BPH.

1. Urology 1996, 47: 942-947
2. World J Urol 2002, 19: 443-52