

## NON-INVASIVE MEASUREMENT OF BLADDER PRESSURE: MINIMUM VOIDED VOLUME AND TEST/RE-TEST REPRODUCIBILITY

### Aims of Study

Work is in progress to determine if bladder contractility can be assessed non-invasively using a modified paediatric blood pressure cuff placed around the penis. When voiding is established the cuff is progressively inflated until flow interruption. The cuff is then rapidly deflated and, when voiding resumes, the inflation cycle is repeated. Typically, 2 or more measurements can be performed during each void. Our preliminary work has demonstrated that cuff pressure at flow interruption ( $p_{\text{cuff,int}}$ ) reflects intra-vesical isovolumetric pressure ( $p_{\text{ves, isv}}$ ) (1). The aims of this study were: -

1. To assess the minimum voided volume (VV) for performance of the 'cuff test'.
2. To assess test/re-test reproducibility, taking into account the effect of VV.

### Methods

Male patients with lower urinary tract symptoms (LUTS) were recruited to this study. For every void during which a 'cuff test' was performed the total VV was recorded. An estimate of  $p_{\text{cuff,int}}$  was calculated for every inflation cycle performed during a single void by plotting flow rate against cuff pressure. We excluded traces in which the flow did not resume immediately upon cuff deflation or was not interrupted. Erratic or atypical traces were also disregarded.

For test/re-test assessment the patients performed 2 voids, on separate occasions, generally within 4 weeks. If multiple inflation cycles yielded a number of  $p_{\text{cuff,int}}$  estimates during a single void, the mean was calculated to give a single value for comparison. The data is presented graphically and the Bland Altman statistic quoted (mean difference between tests  $\pm$  standard deviation of the difference)

### Results

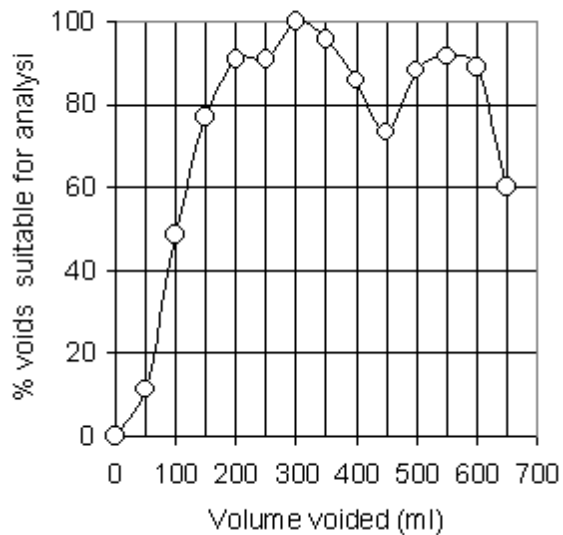
79 male patients with LUTS (mean age 64 years, range 20-88) provided 219 voids from which  $p_{\text{cuff,int}}$  could be estimated. A further 60 voids did not generate any inflation cycles meeting the criteria for analysis and were disregarded. The effect of VV on the likelihood of obtaining an interpretable measurement is plotted in Figure 1.

26 of the 79 male patients (mean age 62 years, range 46-77) provided 2 voids, on separate occasions, from which estimates of  $p_{\text{cuff,int}}$  could be obtained for test/re-test analysis. The average difference in the mean estimate of  $p_{\text{cuff,int}}$  between void =  $-10 \pm 24$  cm H<sub>2</sub>O. If a minimum VV requirement of  $\geq 150$  mls is imposed, 19 subjects remain suitable for test/re-test analysis with the average difference in recorded  $p_{\text{cuff,int}}$  =  $-2 \pm 16$  cm H<sub>2</sub>O.

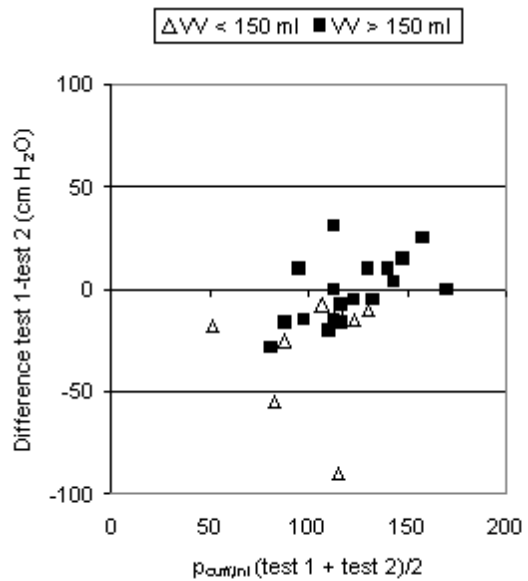
### Conclusions

It is accepted that meaningful measurement of maximum flow rate requires a VV  $\geq 150$  ml and there may be a similar requirement for the cuff test. Indeed, given the time taken to perform the test, up to 20 seconds, it is not surprising there is a minimum VV requirement. We are continuing to develop a protocol for reliable cuff test interpretation. Test/re-test variability is comparable with that found for invasive bladder pressure studies.

**Figure 1:** The percentage of voids giving an interpretable result against the total voided volume (79 patients)



**Figure 2:** Bland Altman plot for test/re-test analysis with respect to voided volume (26 patients)



**References**

1. Non-invasive measurement of bladder pressure by controlled inflation of a penile cuff: a comparison with simultaneous measurements in patients and volunteers. 2002. Journal of Urology. 167: 1344-47