rate cut-off value. When the interrupted flow rate exceeded 5.6 ml/s, the non-invasive bladder pressure reflected the invasive bladder pressure in 80% of the non-obstructed, equivocal and obstructed patients in this population.

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A NEW METHOD FOR NON-INVASIVE ASSESSMENT OF BLADDER PRESSURE DURING VOIDING COMPARED WITH SIMULTANEOUS INVASIVE URODYNAMICS

Aims of study

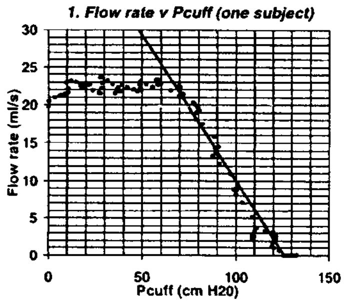
We have developed a new method for measuring bladder contraction pressure non-invasively during voiding. A penile cuff (1) is inflated incrementally, after voiding has commenced, until flow is interrupted. The cuff pressure is then released to allow flow to continue. This cycle can be repeated until voiding is complete. As with the condom catheter method (2, 3), reliance is placed on bladder contraction being maintained and the urethra remaining open during interruption so that, when fluid is stationary, pressure in the penile urethra equals bladder pressure (plus height difference). The method also relies on penile urethral pressure being equal to cuff pressure, which our preliminary work has confirmed for wider cuffs (approximately 1.5 times penile diameter). The method overcomes the problem of leakage associated with the use of a condom catheter, is less intrusive of the patient's privacy, and is quick and easy to apply. This study compares measurements made using the new technique with data obtained simultaneously from invasive urodynamics in healthy volunteers and patients. Particular aims were 1. to compare the interrupting cuff pressure with the simultaneously recorded isovolumetric bladder pressure, and 2. to observe the effect of the interruption on bladder pressure.

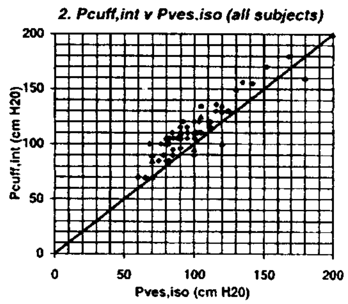
Methods

7 healthy volunteers (mean age 42, range 34 to 53) and 8 patients with voiding symptoms (mean age 60, range 50 to 75) underwent conventional, medium fill urodynamics using a 8F double lumen bladder catheter (MediPlus). A 5.4 (or 4.6) cm wide paediatric blood pressure cuff was fitted around the penis, the bladder was refilled and the subject was asked to void. Once voiding was underway, the cuff was inflated in steps of 10 cm H_2O, each step lasting for 0.75 s (and 0.5 and 1.0 s in repeat studies for the volunteers). When flow stopped the pressure was released so that flow could continue and the cycle was repeated until voiding ended. Precautions were taken to avoid straining. Flow rate (adjusted for delay) was plotted graphically against cuff pressure for each cycle of inflation and pressure at interruption of flow (*Pcuff,int*) was measured from this graph. The invasively measured bladder pressure at the time of interruption (ie: the isovolumetric contraction pressure, *Pves,isv*) was measured and compared with the interrupting cuff pressure (*Pcuff,int*). The difference between the isovolumetric pressure and the bladder pressure at maximum flow rate was measured (*Pves,isv* - *Pves,Qmax*). Abdominal pressure (*Pabd*) during voiding was also measured.

Results

The graph of (delay adjusted) flow rate against cuff pressure typically shows first a plateau region and then a steady decrease as the interrupting pressure is approached (Figure 1). This allows *Pcuff,int* to be measured more accurately by extrapolation (where the line drawn crosses the pressure axis). For each inflation cycle performed, the pair of values *Pcuff,int* and *Pves,isv* was plotted as a point on an X-Y scatter plot (Figure 2; healthy volunteers ◆, patients ▲). The line of identity is shown. For all the data, the Pearson correlation coefficient is 0.92 and the difference *Pcuff,int* - *Pves,isv* is 12.3 ± 9.8 cm H_2O (mean ± standard deviation).





The pressure difference *Pves,iso - Pves,Qmax* is 21 ± 14 cm H_2O for the volunteers and 6 ± 6 cm H_2O for the patients (significant difference: $p < 0.05$). The mean abdominal pressure during voiding is 38 ± 8 cm H_2O.

Conclusions

1. The rise in bladder pressure between maximum flow and interruption is expected from theory. The significantly lower rise in bladder pressure for the patients could indicate that, in the presence of outflow obstruction, the bladder is already operating closer to the isovolumetric limit. This merits further investigation.

2. This study provides good evidence that this new method of controlled interruption of voiding using a penile cuff gives a reliable estimate of isovolumetric bladder contraction pressure. This method non-invasively provides additional objective data which could help the management of male patients with voiding symptoms without recourse to full urodynamics. The method is well tolerated and is quick and easy to apply.

1. Neurourol. Urodyn. 14: 101-114 (1995)
2. J. Urol. 151: 323A (1994)
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A VARIABLE RESISTANCE CATHETER FOR NON-INVASIVE MEASUREMENT OF THE BLADDER PRESSURE

AIMS OF STUDY

In a previous study it was shown, that on the basis of a non-invasively measured isovolumetric bladder pressure and a separately measured maximum flow rate, an accurate non-invasive diagnosis of infravesical obstruction seems possible in male patients [1]. For measuring the isovolumetric pressure, an external condom catheter was used to mechanically interrupt the flow rate. In obstructed patients, the pressure rise in the condom sometimes caused a sphincter contraction, which made the bladder pressure measurement unreliable. As an alternative to this measurement, we developed a variable resistance catheter (patent pending) for non-invasively measuring bladder pressures at different outflow resistances, i.e. without completely interrupting the flow rate. The aim of this study was to investigate if, using this new catheter, the isovolumetric bladder pressure can be estimated.