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NON-INVASIVE ESTIMATION OF BLADDER PRESSURE USING AN AUTOMATED PENILE CUFF TECHNIQUE

Aims of Study

Conventional pressure-flow studies (PFS) allow an objective urodynamic assessment of male patients presenting with lower urinary tract symptoms (LUTS) being considered for prostate surgery, but are invasive and uncomfortable. In previously published work we proposed and validated a method for non-invasive measurement of bladder pressure using an inflatable penile cuff, demonstrating that cuff pressure at flow interruption ($p_{cuff,int}$) reflects intra-vesical isovolumetric pressure ($p_{ves,isv}$) (1). In initial studies the cuff was inflated and deflated under manual control. After further development, the test is now fully automated with a standardised protocol. A study is in progress to evaluate the clinical usefulness of the technique. Here we present the interim analysis of the first 6 months' data comparing the readings obtained from the automated 'cuff test' with readings obtained from simultaneous invasive PFS.

Methods

A paediatric blood pressure cuff is placed around the penis and the subject requested to void. A continuous flow rate (Q) of $\geq$ 1 ml s^{-1} for 2 seconds is taken by the computer to indicate that voiding has commenced. The cuff is then automatically inflated in a linear fashion at a rate of 10 cm H_2O s^{-1} until flow interruption. After Q $\leq$ 0.5 ml s^{-1} for 2 seconds the cuff is rapidly deflated and, when voiding resumes, the inflation cycle is repeated. Typically, 2 or more measurements can be performed during each void.

Simultaneous rectal and intra-vesical pressures are recorded via fluid filled lines connected to external pressure transducers zeroed at the level of the symphysis pubis. For analysis the data is presented in graphical form with the Bland Altman (BA) statistic quoted (mean difference [$p_{cuff,int}$ - $p_{ves,isv}$] $\pm$ standard deviation of the difference)

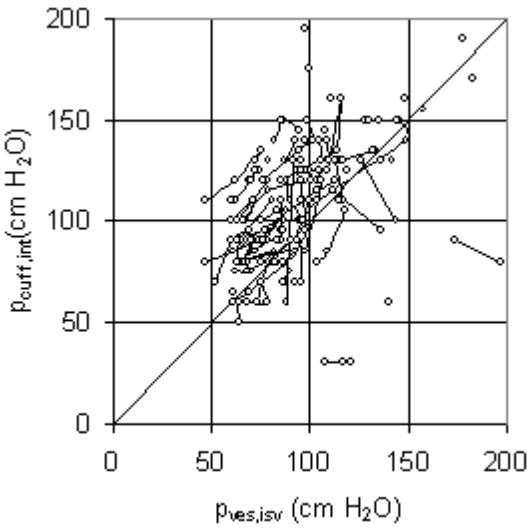
Results

So far 79 male patients (mean age 64 years, range 20-88) have each provided a single void during which the 'cuff test' was performed with simultaneous invasive CMG monitoring. 168 separate inflation cycles were suitable for analysis. The simultaneous $p_{cuff,int}$ and $p_{ves,isv}$ are recorded in Figure 1. On average p_{cuff} overestimates $p_{ves,isv}$ by 14 $\pm$ 31 cm H_2O.

Conclusions

The automated test still estimates $p_{ves,isv}$. The $p_{cuff,int}$ is generally in excess of the invasively recorded $p_{ves,isv}$, partly due to the position of the cuff on average 9 cm (SD $\pm$ 2) below the symphysis pubis baseline for pressure recording. In previous work we demonstrated excellent pressure transmission from the cuff to the urethral lumen in a static situation (ie the subject was not voiding or attempting to do so) (2). Considering this, the data in Figure 1 shows greater variability than anticipated and the cause for this will require further investigation. Regardless of this concern, we believe the test provides information about bladder contractility, which should be useful in the clinical assessment of men with LUTS.

Figure 1: $p_{cuff,int}$ against the simultaneously recorded $p_{ves,isv}$. The connected data points are separate cuff inflations performed during the same void



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