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Title: NON-INVASIVE BLADDER PRESSURE MONITORING – HOW DOES INTERRUPTING THE URINARY STREAM AFFECT INTRA-VESICLE PRESSURE?

Aims of study

It is now widespread practice to use an invasive pressure-flow study (PFS) to assess patients with suspected bladder outflow obstruction (BOO). Concern with this technique centres around its invasive and unpleasant nature for patients. We are developing a non-invasive method of measuring bladder pressure by means of an inflatable cuff placed around the penis that removes the need for catheterisation and rectal lines. The test involves inflation of the cuff to interrupt urinary flow during voiding to allow measurement of isovolumetric intra-vesicular pressure ($P_{ves,iso}$). After flow is interrupted the cuff is deflated and voiding allowed to continue. We feel it is important that flow should recover, to indicate that detrusor contraction was maintained for the duration of the measurement. Typically 3 or 4 inflation cycles can be performed during a single micturition. In this study we have investigated the following questions:-

1) How does the voiding pressure after interruption and resumption of flow compare with voiding pressure before the interruption of flow commenced?
2) Does interruption of the urinary stream cause a rise in bladder pressure as predicted by current theory of detrusor physiology?

Methods

Multiple cuff inflation cycles were analysed for 5 asymptomatic controls (32 inflation cycles in total) and 8 patients (32 cycles) referred for PFS. Each subject underwent the cuff test with simultaneous invasive PFS. A paediatric blood pressure cuff was placed around the penis and inflated during voiding until flow was interrupted or a pressure of 200 cm H_2O reached. The cuff was then deflated so that voiding could resume. The detrusor pressure and intra-vesicular pressure were recorded during steady voiding before cuff inflation ($P_{det,pre}$ and $P_{ves,pre}$) and at recovery of steady flow after deflation ($P_{det,post}$ and $P_{ves,post}$). The maximum or isovolumetric values ($P_{det,iso}$ and $P_{ves,iso}$) during the period of zero flow were also recorded. Only inflation cycles with recovery of steady urine flow were analysed.

Results

When the urinary stream recovers P_{det} and P_{ves} return to their pre-interruption values in both patients and controls (correlation co-efficients: P_{det} control group 0.90, patient group 0.92 and $P_{det,pre}$ - P_{det} control group: mean

Fig 1: P_{det} before and after cuff inflation during voiding

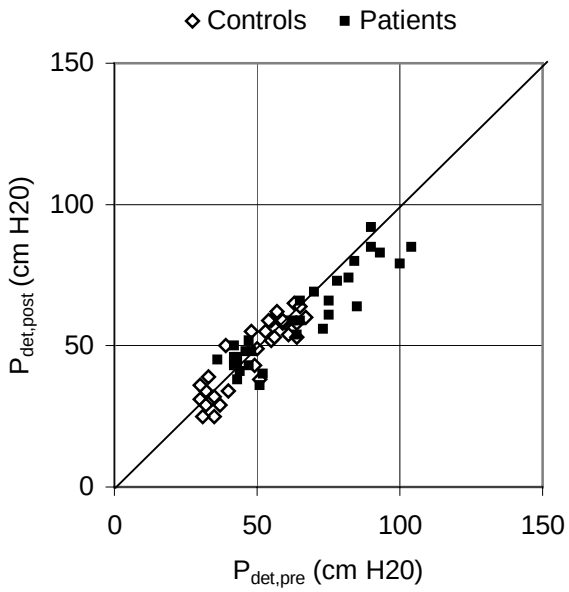
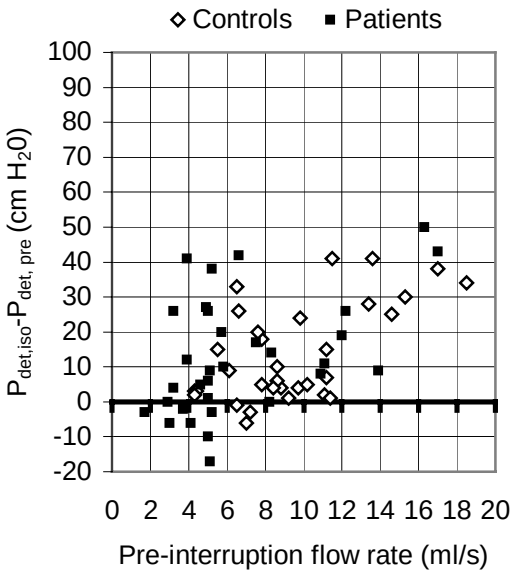


Fig 2: Change in P_{det} during cuff interruption of the urinary stream against pre-inflation flow



1.56 SD +/- 5.66, patient group: mean 4.84 SD +/- 8.16, Bland Altman). $P_{det,iso}$ and $P_{ves,iso}$ tended to be greater than $P_{det,pre}$ and $P_{ves,pre}$ during constant voiding (correlation co-efficient of increase P_{det} [ie $P_{det,iso}$ - $P_{det,pre}$] with pre-interruption flow rate - controls 0.59, patient 0.46).

Conclusions

After the interruption of the urinary stream was removed and free flow resumed P_{det} and P_{ves} return to their pre-interruption values (fig 1). The fact that this occurs for both P_{det} and P_{ves} implies that abdominal pressure remains a constant factor during the test. Current models of bladder physiology (1,2) suggest that detrusor power is a function of P_{det} and flow, and that as one decreases the other increases if power remains constant. An isovolumetric increase in bladder pressure should therefore occur if flow is prevented and this was generally the case in our data although the magnitude of the effect was not as large or consistent as might would been predicted (fig 2).

References

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