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THE FIRST METHOD OF CONTINUOUS AND NON-INVASIVE BLADDER PRESSURE MEASUREMENT

Hypothesis / aims of study

Measurement of bladder pressure assists an informed choice for treatment of LUTS. Currently, invasive pressure-flow studies provide a continuous record of bladder pressure; alternatively a few discrete measurements of isovolumetric pressure can be made non-invasively during a void [1]. A key improvement on the non-invasive method would be to measure bladder pressure continuously. We hypothesise that by using a penile cuff to control flow at a low rate, we can achieve this. During voiding, pressure in the cuff should be lower than in the bladder, due to the flow of urine, but we expect the difference to be minimised by keeping the flow rate low. Here we present data from our preliminary studies to assess agreement between cuff pressure and bladder pressure measurements.

Study design, materials and methods

23 patients referred for invasive pressure-flow studies for routine clinical care gave informed consent to undergo the new technique. Following standard PFS using a dual lumen catheter, patients were re-filled at 50ml/s. Upon strong desire to void, the cuff was inflated to 100cmH_2O and the patient asked to void. On commencement of flow, or the feeling that flow would have started if the cuff was not present, the cuff pressure was automatically adjusted to allow flow and maintain the flow rate at a constant 2.5ml/s. Measurements of cuff pressure (p_{cuff}), vesical (p_{ves}) and rectal pressure (p_{abd}), flow rate (Q), filled (V_{fill}) and voided volume (V_{void}) were recorded.

Results

Of the 23 men recruited, eight gave good agreement between p_{ves} and p_{cuff}, quantified by r.m.s. difference < 10cmH_2O between the two. The figure shows three examples of good traces with their respective flow traces. The RMS values are calculated over the period where the cuff controls the flow.

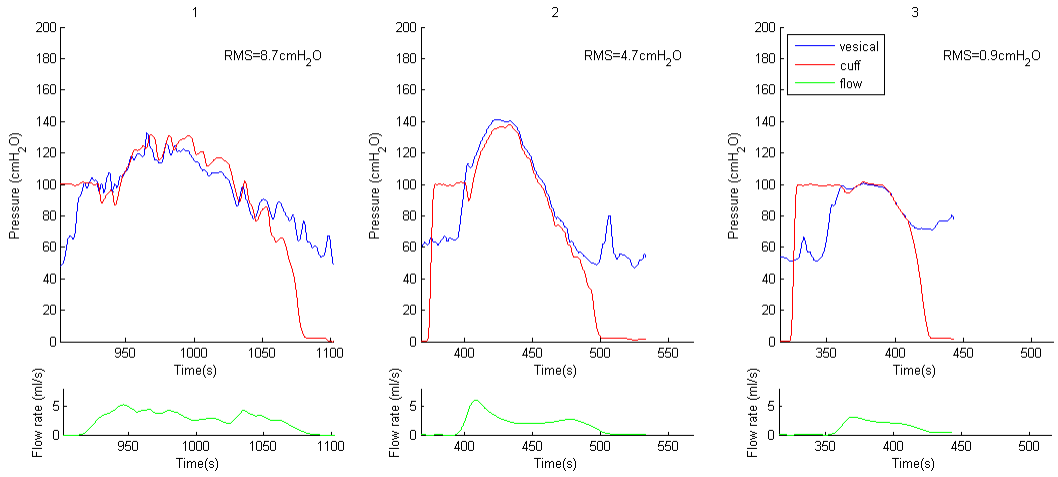

Fig 1, Simultaneous measurements of vesical pressure (blue), cuff pressure (red) and flow rate reduced by the cuff (green) are shown for the duration of the void with the cuff in place. The root mean square (r.m.s) differences between the invasively measured data and the cuff data over the flow controlled section is displayed in the top right hand corner.

There was a range of reasons for the less successful studies, some relating to the preliminary nature of the study. Six patients had Q_{max}<7ml/s in conventional PFS, resulting in either a constant offset of >10cmH_2O or poor agreement. Three were excluded due to straining and/or intermittency. One was excluded due to a technical error. The remaining five did not produce promising results because the cuff inflation/deflation was started prematurely. This could have been because of insufficient explanation, indefinite sensation of flow on the part of the patient, user error, or inhibition of flow due to the cuff.

Interpretation of results

The preliminary experiments show encouraging results, and demonstrate that it is feasible to make continuous non-invasive recordings of bladder pressure by reducing flow rate using a penile cuff. In 8 patients, the pressure drop anticipated between the bladder and cuff due to the flow rate appears minimal as p_{cuff} is very close to invasively measured p_{ves} as demonstrated by the r.m.s values, which were below 10cmH_2O. This indicates that the flow rate is sufficiently low. Use of the technique in a variety of patients allowed identification of groups in which the technique is unlikely to produce reliable results, such as low flow rates <7ml/s and those with intermittent flow. Greater experience for the operators in using the technique will continue to improve the identification of when to start the machine, and how to explain the concept to patients. The section where the measurement of p_{ves} should be accurate can be predicted by analysing the control of the flow rate. An algorithm has been developed which allows use of the method without simultaneous invasive measurements. We are therefore currently using the technique on healthy volunteers to further investigate quantification of bladder contractility and provide normative data.

Concluding message

We present preliminary validation of a proposed new method to measure bladder pressure continuously and non-invasively. Our results are encouraging and support our hypothesis that use of the technique can give a continuous, accurate estimate of p_{ves}

without catheterisation. We expect that further studies of this technique will establish its usefulness as a clinical tool for men with LUTS.

References
1. J Urol (2002) 167; 1344-1347

Specify source of funding or grant	**None**
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What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
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Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**