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NON-INVASIVE BLADDER PRESSURE: THE CASE FOR USING A MODIFIED ICS NOMOGRAM

Aims of Study

The ICS nomogram classifies patients as obstructed (O), equivocal (E) or unobstructed (U) using maximum flow (Q_{max}) and detrusor pressure at maximum flow ($p_{det,Qmax}$) from an invasive pressure flow study (PFS) (1). The penile-cuff pressure required to interrupt flow ($p_{cuff,int}$) provides a non-invasive estimate of isovolumetric bladder pressure ($p_{ves,isv}$) (2). This paper considers the expected relationship between $p_{cuff,int}$ (or $p_{ves,isv}$) and $p_{det,Qmax}$ and the modification required to the ICS nomogram to produce a nomogram for the cuff test. Non-invasive data from 2 large urology departments were used to assess the modified nomogram.

Methods

On the ICS nomogram, the line separating obstructed from equivocal (O/E line) passes through 40 cm water at zero flow and has a slope of $2xQ_{max}$. Previously reported results (see below) suggest two possible adjustments for non-invasive data: offset and slope.

Step 1(Offset): The cuff test estimates bladder pressure (p_{ves}), which includes abdominal pressure and also a small component due to the height difference between the cuff and bladder. The mean ($\pm$ SD) abdominal pressure during voiding and height difference were measured in patients with lower urinary tract symptoms to estimate the correction required.

Step 2 (Slope): The non-invasive technique measures $p_{ves,isv}$, flow being zero at the time of measurement. $p_{ves,isv}$ is expected to be higher than p_{ves} at full flow, by an amount dependent on the flow rate (Q) prior to interruption. The slope of the O/E line should be increased to allow for this. The pressure increase was plotted against pre-interruption flow rate in patients undergoing cuff test plus PFS in order to estimate the required correction.

Step 3 (Modified Nomogram): Using the results from steps 1 and 2, a modified nomogram was proposed.

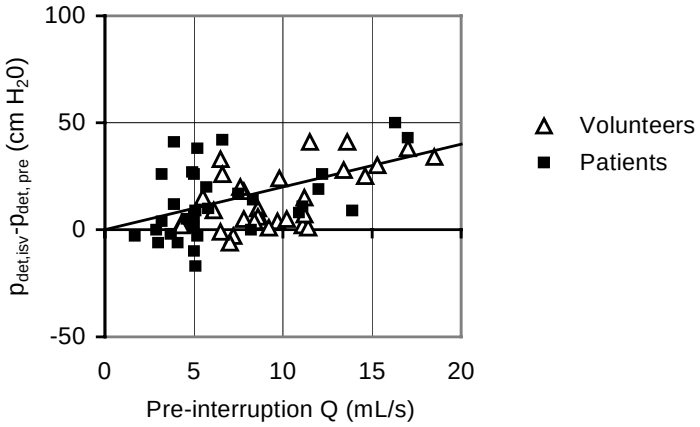
Step 4 (Patient data): Data was collected using an identical non-invasive technique from 2 UK urology departments. Patients underwent a cuff test and, on a separate occasion, invasive PFS. From the cuff test, $p_{cuff,int}$ and Q_{max} (excluding surges after cuff release) were estimated for each patient and plotted on the proposed nomogram. The symbol used indicated their classification from their separate invasive PFS.

Results

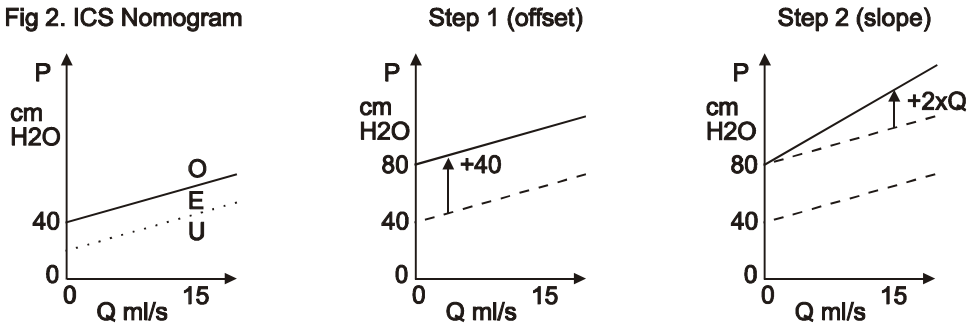
Step 1: The mean ($\pm$ SD) abdominal pressure during voiding for 76 patients was 35 ($\pm$9) cm water (3). With the measured height difference of 8.8 ($\pm$ 1.4) cm, the O/E line should be offset approximately 40 cm, giving an intercept of 80 cm water.

Step 2: Figure 1 illustrates the pressure rise to $p_{ves,isv}$ as a function of pre-interruption flow rate for 13 subjects (64 inflation cycles). There is variability between individuals, but the average pressure rise is approximately 2 times the flow rate (4).

Fig 1. Pressure increase v flow rate

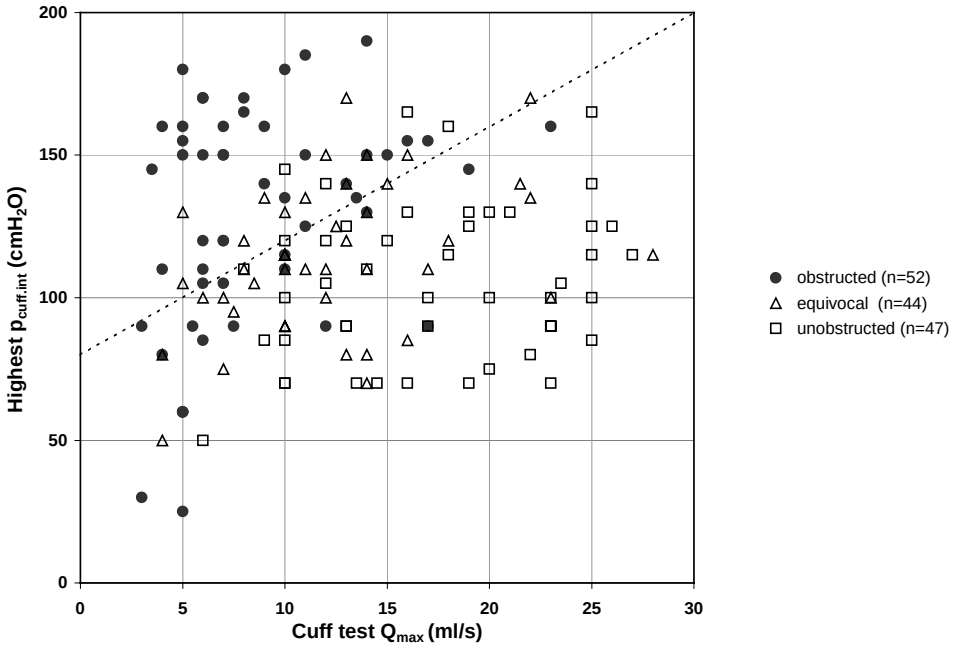


Step 3: Figure 2 illustrates the development of the modified nomogram using the results from steps 1 and 2. The total slope after applying step 2 is 4xQ.



Step 4: Figure 3 illustrates the non-invasive data plotted on the modified nomogram for 57 and 86 patients from the two centres, with indication of their ICS classification from the separate invasive PFS (•=O, ∆=E, ~=U).

Fig 3. Combined data provisional nomogram (n=143)



Conclusions

A rationale and supporting data have been provided for a modified ICS nomogram which could be used for non-invasive data recorded with the cuff interruption technique. The separation of patients classified invasively looks encouraging but further refinement may be required. The technique may provide useful, objective data intermediate between flow rate alone and full PFS for men with LUTS.

References

(1) Neurourol & Urodyn 16: 1-18 (1997)
(2) J Urol 167: 1344 – 1347 (2002)
(3) Neurourol & Urodyn (In press)
(4) Neurourol & Urodyn 20: 382-384 (2001)