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MULTIPLE FLOW MEASUREMENTS IN LUTS – DOES THE EVIDENCE STAND UP?

Hypothesis / aims of study

Testing for a reduced maximum flow rate (Q_{max}) is commonly the first line of screening for men with lower urinary tract symptoms (LUTS) suggestive of bladder outflow obstruction. There is a body of opinion that two or more sequential flow rates increase the diagnostic value of maximum flow rate measurements, as reported in a 1996 study of 165 men with LUTS [1]. Two years later, a much larger study of 1271 men found similar overall predictive values for Q_{max} but did not report any advantage in multiple flow measurements [2].

Multiple flow rate measurements put greater demands on both the patient and the service provision. In this study we re-examine the evidence from the 1996 study using a more detailed analysis, which we believe represents the current practice.

Study design, materials and methods

We used the data exactly as reported in the 1996 study [1]. The authors studied 165 men with LUTS, who each performed up to four flow-rate tests. 157 of the men then underwent full cystometry; 95 were *obstructed* and 62 were *equivocal/unobstructed* according to the Abrams-Griffiths nomogram.

The authors measured highest Q_{max} from 1, 2, 3 and 4 consecutive flow measurements, and used each of four flow rates (8, 10, 12, 15 mL/s) to separate the *obstructed* and *equivocal/unobstructed* groups. From the subjectively 'best' sensitivity & specificity, they recommend that LUTS clinics should *… perform three free-flows, using a threshold of 10 mL/s on the maximum of the three flows*.

We propose a more complete analysis, calculating receiver-operator characteristic (ROC) curves for 1, 2, 3 and 4 flow measurements. The ROC measures the trade-off of sensitivity and specificity; the area under the curve is always in the range 0 to 1, where 1 indicates an ideal diagnostic test, and 0.5 indicates a test no better than chance alone. If there is any value in performing multiple flow tests, then the area under the corresponding ROC curves should be higher.

Results

In figure 1, the ROC curves are plotted using the data from the original paper [1].

Table 1 gives the areas under the ROC curves for 1, 2, 3 and 4 consecutive flow measurements, plus the corresponding confidence intervals.

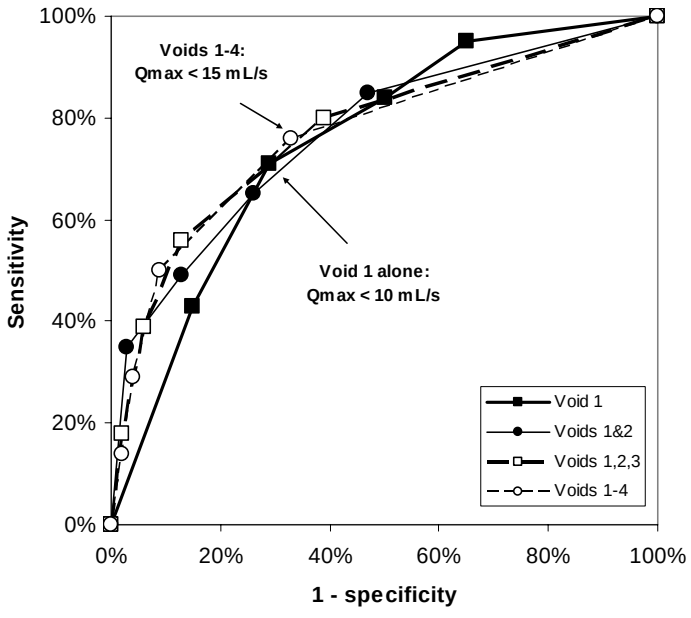

Figure 1 – ROC curves for detecting obstruction by four measurement protocols.

Means for determining Q_{max}	Area under ROC curve	95% confidence interval
1st void only	0.750	0.675 to 0.825
Best from voids 1 & 2	0.769	0.697 to 0.841
Best from voids 1, 2, 3	0.772	0.700 to 0.844
Best from voids 1 to 4	0.766	0.694 to 0.839

Table 1 – Areas under ROC curves for four different Q_{max} measurement protocols. Confidence intervals are calculated according to [3]; this method makes some assumptions about the distribution of data and tends to give relatively tight confidence intervals.

Interpretation of results

The maximum from three flow-rate measurements [1] tends to give a higher estimate of Q_{max}, and may be more representative of the patient's true maximum flow rate. To achieve a given sensitivity and specificity, the threshold used to diagnose obstruction will change. A threshold of Q_{max} < 10 mL/s from a single void gives similar sensitivity and specificity to a threshold of Q_{max} < 15 mL/s from the best of four voids (figure 1). However, the four ROC curves are visibly very similar, and the areas under the curves are almost identical (table 1).

Since there is considerable overlap between the flow rates of obstructed and non-obstructed men, it would clearly be impossible to achieve an ideal diagnostic test using Q_{max} alone.

The best achievable ROC (figure 2) can be predicted from Q_{max} measurements in obstructed and unobstructed populations, estimates for which are given in [1] and in [2]. This represents the best diagnostic performance that could be achieved using an absolutely accurate Q_{max}, and assuming no additional errors are introduced by the patient, by the flow meter, or by the operator reading the trace.

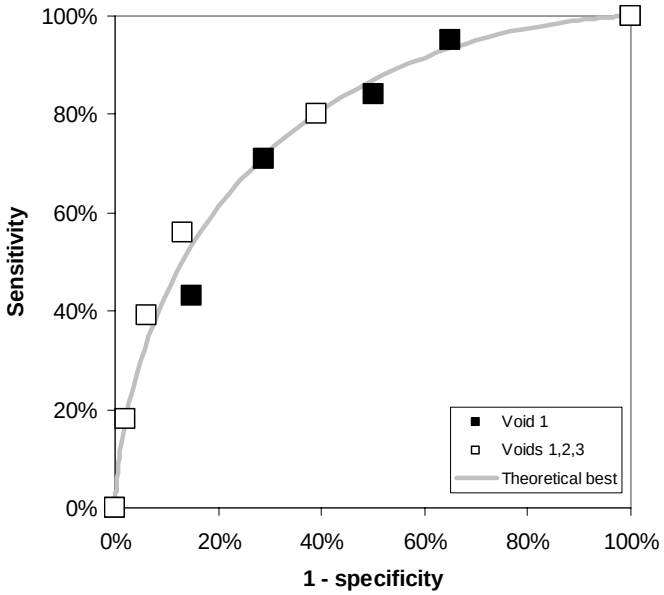

Figure 2 – The theoretical best ROC from population statistics (area under curve = 0.78). For comparison, we reproduce the actual performance [1] for a single void, and for three voids as recommended by the authors.

The actual sensitivities and specificities reproduced from [1] lie close to the predicted best line. The area under this 'best' ROC is 0.78, which corresponds remarkably well to the actual areas from Table 1. We believe there is no clinically worthwhile improvement in diagnostic value to be gained using multiple flow rate measurements.

Concluding message

There is no evidence that multiple flow rate measurements improve the diagnostic value of the flow-rate test. A single, well-conducted measurement of Q_{max} approaches the fundamental limitations of maximum flow rate as a diagnostic test for BOO.

References

[1] The value of multiple free-flow studies in men with lower urinary tract symptoms. *British Journal of Urology 1996; 77: 813-18*.

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[3] The meaning and use of the area under a receiver-operating characteristic (ROC) curve. *Radiology, 1982; 143:29-36.*