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INTERPRETATION OF THE MAASTRICT-HANNOVER DETRUSOR UNDERACTIVITY NOMOGRAM

Hypothesis / aims of study

Oelke et al recently described a new approach to classifying detrusor underactivity (DU) in men [1]. The authors proposed the Maastrict-Hannover (MH) nomogram where maximum Watts factor (W_{max}) is plotted against bladder outlet obstruction index (BOOI), with the higher BOOI, lower W_{max} area classified as DU. W_{max} and BOOI are derived from data collected during invasive urodynamic studies.

Both BOOI and W_{max} depend on urine flow rate, meaning that with knowledge of BOOI and flow rate, W_{max} can be determined. We aimed to calculate, using the equations for BOOI and W_{max}, 'flow contour' lines of equal flow rate on the MH nomogram in order to better understand its interpretation.

Study design, materials and methods

The equations for BOOI [2] and Watts factor [3] are as follows:

$$BOOI = P_{detQmax} - 2Q_{max}$$

$$WF = (1/2\pi)(P_{det} \cdot v_{det} + a \cdot v_{det} + b \cdot P_{det})$$

$$\text{where} \quad v_{det} = (Q/2)(3(V + Vt)/4\pi)^{-2/3}$$

(Here, $P_{detQmax}$ is detrusor pressure at the point of maximum flow rate, Q_{max} is maximum flow rate, P_{det} is detrusor pressure, v_{det} is velocity of shortening of detrusor circumference, Q is flow rate, V is bladder volume, and a, b and Vt are constants.)

We rearranged these equations in order to give W_{max} as a function of BOOI and flow rate, allowing lines of constant flow to be plotted on the MH nomogram. This required a fixed estimation (we used 300 ml) for the bladder volume at which W_{max} occurs, and the assumption that W_{max} coincides with Q_{max}. In order to test this assumption, W_{max} was compared to Watts factor at the point of Q_{max} in 38 male patients with lower urinary tract symptoms undergoing urodynamics as part of their standard care. Urodynamics was performed according to ICS guidelines.

Results

In the case of equating flow rate to zero, W_{max} is given by $^{3}/_{10\pi}$BOOI. Figure 1, left, shows the patient data presented by Oelke et al and their MH nomogram centile lines. Our zero flow rate line is superimposed in red and is validated by the fact that the datapoints reach this line but all patients lie above it.

Figure 1, right, shows contours for a range of physiological flow rates (from zero to 20 ml/s in increments of 5 ml/s). We found that these lines closely resemble the centiles on the MH nomogram.

Of the 38 patients studied, data from five patients were excluded due to W_{max} and/or Q_{max} being uninterpretable because of noise, leaving 33 cases for analysis. The mean (standard deviation) difference between W_{max} and Watts factor at Q_{max} was 0.3 (0.4) W/m^{-2}. The values were within 1 W/m^{-2} in all but two cases, where detrusor overactivity immediately before voiding resulted in W_{max} occurring at the start of the void, and Watts factor then fell towards Q_{max} a few seconds later. Figure 2 shows W_{max} plotted against Watts factor at the point of Q_{max} for these 33 cases.

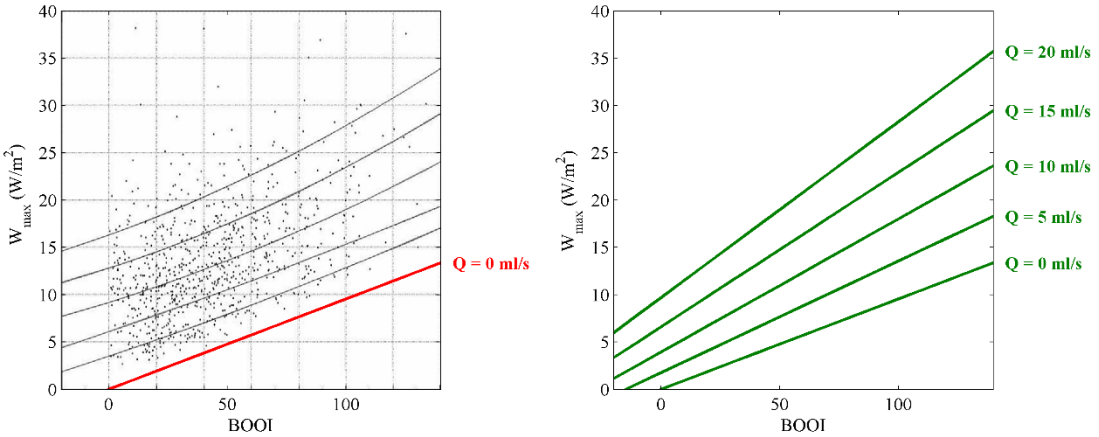

Figure 1. Flow contour lines constructed by equating flow rate in the calculations of BOOI and W_{max}. Left: The zero flow rate (Q) contour line superimposed over the MH nomogram and Oelke et al's datapoints, validated by the fact that no points lie beneath this line. Right: Flow contour lines from zero to 20 ml/s, demonstrating their resemblance to the MH nomogram centile lines.

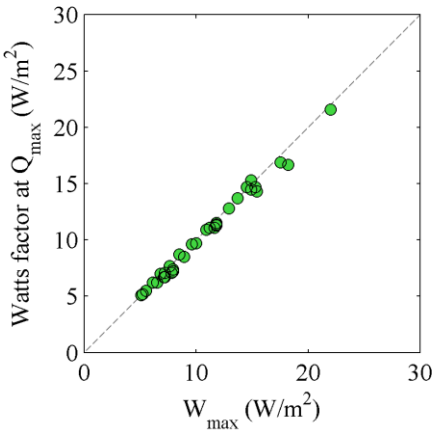

Figure 2. Left: A comparison between W_{max} and the Watts factor at the point of Q_{max} for 33 male patients undergoing urodynamics as part of their standard care for investigation of lower urinary tract symptoms. The dashed grey line is the line of unity.

Interpretation of results

The authors justify their suggested approach on the basis that bladder outlet obstruction brings about an increase in detrusor contractility and that its interpretation should therefore vary according obstruction level. However, owing to the interdependence of the nomogram's axes, it is in effect applying a threshold to flow rate in order to classify detrusor underactivity, and thus discarding the additional information that is provided by invasive urodynamics, namely detrusor pressure. Accordingly, as with flow rate, the nomogram does not distinguish between a low flow situation due to high pressure with high outlet resistance from one due to low pressure and low outlet resistance. This is the aim of urodynamics, in order to select appropriate management, or advise patients of the likelihood of success for treatment of obstruction.

Concluding message

The Maastrict-Hannover nomogram suffers from the same limitations as flow rate in diagnosing detrusor underactivity. Our preferred method to classify detrusor contractility remains the Schäfer nomogram.

References

1. Neurourol Urodyn 2016;35(8):980-6
2. Neurourol Urodyn 1989;8(1):17-27
3. BJU Int 1999;84(1):14-5

Disclosures

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