Effect of metabolic syndrome on the lower urinary tract of men assessed on MRI

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Introduction

- Lower urinary tract symptoms (LUTS) are a collection of symptoms involving storage and voiding that affect quality of life.
- Prior studies have shown an association between LUTS and anatomic changes of the bladder and prostate
- Benign prostate enlargement (BPE) is weakly correlated with LUTS and not correlated with symptom severity.
- Prostate inflammation which contributes to collagen deposition and fibrosis are highly correlated with symptom severity.
- Metabolic syndrome, a collection of comorbidities that contribute to chronic, low-grade inflammation, leads to detrusor hypertrophy.

- Aim: To quantify functional and anatomic changes of the lower urinary tract in men without and with metabolic syndrome with MRI.

Methods

- MRI analysis
  - The bladder serosa (A), mucosa (B) and prostate (C) were segmented to create 3D anatomic renderings.
  - Bladder wall volume (BWV), postvoid residual (PVR), and prostate volume (PV) were quantified from the 3D anatomic renderings. (Figure 1)
  - 200mm² region-of-interest (ROI) was placed around the prostatic urethra, at the level of the verumontanum, on b800 Apparent Diffusion Coefficient (ADC) map using the T2-weighted MRI for anatomic reference. (Figure 2) ADC is a quantitative measure of cellular density (higher cellularity = lower ADC). Clinically significant prostate cancer has an ADC of 800.

- Statistical Analysis
  - IPSS stratified into 3 categories: Mild (0-7), Moderate (8-19), Severe (20+)
  - Prostategland defined as PV > 40 cc
  - Wilcoxon rank sum, Chi-square and Fisher’s exact tests used to explore differences in anatomic (BWV, PVR, PV) and functional (ADC) metrics across symptom severity in men without and with metabolic syndrome

- Exclusion Criteria
  - Clinical data (n=43) and incomplete MRI (n=40)
  - Prior prostate surgery/radiation (n=13), missing clinical data (n=43) and incomplete MRI (n=40)
  - Weaknesses: Retrospective design, lack of waist circumference measurement

Results

- Study population
  - 147 men [median age 66.5 years (IQR: 62-71) and median BMI of 28.8 (IQR: 27.0-31.9)
  - 56% (82/147) men had prostategland
  - 16% with PV > 80 cc
  - 67% (98/147) had metabolic syndrome
  - 55% (81/147), 39% (57/147) and 6% (10/147) had mild, moderate and severe LUTS

- Study population stratified by metabolic syndrome status
  - Men with metabolic syndrome had higher BMI (27.8 vs 29.6, p=0.002) but similar age, anatomic and functional metrics and symptoms.

- Study population stratified by prostate volume
  - Men with prostategland were more symptomatic (IPSS 5 vs 8, p=0.02), had higher BWV (44 mL² vs 48 mL², p=0.005), PVR (35 cc vs 53 cc, p=0.05) and periurethral ADC (x vs y, p=0.01).
  - Men without and with prostategland were similar in age and had similar BMI and metabolic syndrome status.

- Study population stratified by lower urinary tract symptoms

<table>
<thead>
<tr>
<th>MILD</th>
<th>MODERATE</th>
<th>SEVERE</th>
<th>P-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QOL</td>
<td>&lt;=2</td>
<td>52 (100%)</td>
<td>19 (57.6%)</td>
</tr>
<tr>
<td>&gt;2</td>
<td>0 (0%)</td>
<td>14 (42.4%)</td>
<td>4 (100%)</td>
</tr>
<tr>
<td>PVR</td>
<td>mL</td>
<td>37.1 (19.6-72.7)</td>
<td>49.7 (18.7-71.8)</td>
</tr>
<tr>
<td>BWV</td>
<td>cm³</td>
<td>44.2 (36.3-49.9)</td>
<td>45.4 (37.7-52.7)</td>
</tr>
<tr>
<td>PV</td>
<td>cm³</td>
<td>38.3 (31.7-51.9)</td>
<td>47.6 (35.2-67.8)</td>
</tr>
<tr>
<td>ADC</td>
<td></td>
<td>1355.5 (1294-1419)</td>
<td>1376 (1301-1455)</td>
</tr>
</tbody>
</table>

- No T2 signal in 4 remaining clinical criteria
- When the 4 remaining clinical criteria (hypertension, elevated fasting blood glucose, low HDL and high TAG) coexisted, the subject was considered to have metabolic syndrome

Conclusions

- Men with BPE are more symptomatic, have MRI evidence of anatomic and functional changes of the lower urinary tract.
- Men with worse LUTS have higher BWV and PV and trend toward higher PVR.
- The effect of metabolic syndrome on LUTS, anatomy and function is unclear.
- Weaknesses: Retrospective design, lack of waist circumference measurement

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