Renal Artery FFR

Woo-Young Chung
Seoul National University, College of Medicine
Boramae Medical Center
Cardiovascular Center
Why renal FFR?
Renal artery angioplasty (PTRA)

- Indication of Renal artery angioplasty (PTRA)
  - ≥ 50% stenosis +
    - Uncontrolled hypertension (≥ 3 antihypertensive)
    - Poor or decreasing renal function
    - CHF, Unstable angina

2006 ACC/AHA Practice Guideline
However...

Clinical outcomes of renal a. stenting

- Hypertension improved in 56%
- Hypertension cured in 10%
- Renal function improved in 27%
- Renal function stabilized in 38%
- Restenosis in 16%
- Major complication 2%

Predictor of BP response?
Fractional Flow Reserve

- Physiologic assessment of stenosis in coronary artery disease

\[ \leq 0.80: \text{significant stenosis} \]
\[ \geq 0.95: \text{successful revascularization} \]

no ischemia

How about in renal artery stenosis?
Procedure

- Femoral or brachial approach
- 7 or 8 Fr Guiding catheter Cannulation
- \(0.014\)” or \(0.018\)” stiff guidewire
Renal angiography
Procedure

- Radi® pressure wire
- Pr wire zeroing, outside of body
- Pr equalization btw catheter tip and Pr. wire
- Guiding catheter tip in aorta avoiding catheter damping
- Leaving 014/018 wire anchoring in renal a.
  ** difficult to recannulate catheter into renal artery w/o anchoring wire**
Pressure equalization
Procedure

- Catheter reengagement
- Pr wiring distal to stenosis
- Pull back catheter to avoid damping
- Check baseline FFR

Hyperemia ...

No proven hyperemia inducing agent in renal artery
Intraarterial NG 300ug with catheter re-engaged
PrePTRA FFR

Pr. wire

018" wire
Renal artery stenting
Post PTRA FFR

Pr. wire
Case 1
43 yo male

prePTRA FFR 0.59
Case 1
43 yo male

- BP 182/103mmHg with 3 antiHTN
- BP 108/85 with 3 antiHTN, 1 month

PTRA
Case 2
67 yo female
Case 2
67 yo female

PrePTRA baseline
PostPTRA baseline
Case 1
67 yo male

- BP 150/71 mmHg with 3 antiHTN
- BP 157/76 with 3 antiHTN, 1 month

PTRA

- BP 157/76 with 3 antiHTN, 1 month
Can fractional flow reserve predict the blood pressure response after renal angioplasty?
Blood pressure measurement

- PrePTRA: average BP on day -1
- Post PTRA: average BP on day 1
- 1 month, 3 month office BP
Analysis

• Definition of BP response

\[ \Delta SBP \geq 20\text{mmHg or} \]
\[ \Delta DBP \geq 10\text{mmHg or} \]
decrease of more than 1 in the number of antihypertensive with maintaining BP without aggravation
Results

- Total 28 patients, 35 lesions
- 18 pt. : Unilateral stenosis (18 lesions)
  - 8 pt : bilateral stenosis
    - 7 of 8 – bilateral angioplasty (14 lesions)
    - 1 – unilateral angioplasty (1 lesion)
- 2 pt : single kidney stenosis (2 lesions)
- 33 of 35 lesions : stenting
  - 2 lesions : treated with balloon angioplasty alone

FMD
## Results
### Response vs nonresponse, 1 month

<table>
<thead>
<tr>
<th></th>
<th>Response (n=16)</th>
<th>No response (n=10)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60.82±18</td>
<td>69.7±8</td>
<td>0.23</td>
</tr>
<tr>
<td>Male (%)</td>
<td>47.1</td>
<td>50</td>
<td>1.00</td>
</tr>
<tr>
<td>DM (%)</td>
<td>23.5</td>
<td>40</td>
<td>0.42</td>
</tr>
<tr>
<td>Cr (mg/dl)</td>
<td>1.3±0.5</td>
<td>1.3±0.2</td>
<td>0.50</td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>41.1</td>
<td>20</td>
<td>0.52</td>
</tr>
<tr>
<td>Dyslipidemia (%)</td>
<td>58.8</td>
<td>50</td>
<td>0.71</td>
</tr>
<tr>
<td>ASO (%)</td>
<td>11.8</td>
<td>30</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Man-Whitney test, Chi-Square test
1 month BP Responder

SBP  
P=0.011

DBP  
P=0.063

The Number of Medication  
P=0.030
1 month BP Nonresponder

SBP
P=0.028

DBP
P=0.05

The Number of Medication
P=0.249

unpublished
# Results

## Response vs nonresponse, 1 month

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<thead>
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<th>Response (n=16)</th>
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<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP (prePTRA)</td>
<td>146±15</td>
<td>124±13</td>
<td>0.001</td>
</tr>
<tr>
<td>DBP (prePTRA)</td>
<td>81±10</td>
<td>69±9</td>
<td>0.006</td>
</tr>
<tr>
<td>SBP (day 30)</td>
<td>125±20</td>
<td>137±9</td>
<td>0.019</td>
</tr>
<tr>
<td>DBP (day 30)</td>
<td>76±9</td>
<td>75±8</td>
<td>0.646</td>
</tr>
<tr>
<td>∇SBP (mmHg)</td>
<td>-21±28</td>
<td>11±10</td>
<td>0.003</td>
</tr>
<tr>
<td>∇DBP (mmHg)</td>
<td>-6±14</td>
<td>6±7</td>
<td>0.051</td>
</tr>
<tr>
<td>prePTRA antihypertensive</td>
<td>3.3±1.7</td>
<td>2.0±1.0</td>
<td>0.014</td>
</tr>
<tr>
<td>Day 30 antihypertensive</td>
<td>2.3±2.0</td>
<td>2.4±1.2</td>
<td>0.56</td>
</tr>
<tr>
<td>Renal vein renin</td>
<td>11.6±15.8</td>
<td>5.34±4.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Man-Whitney test
## Results

**Responder vs nonresponder, 1 month**

<table>
<thead>
<tr>
<th></th>
<th>Response (n=21)</th>
<th>No response (n=11)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>prePTRA baseline</strong></td>
<td>0.79±0.22</td>
<td>0.86±0.13</td>
<td>0.79</td>
</tr>
<tr>
<td><strong>prePTRA hyperemic</strong></td>
<td>0.78±0.22</td>
<td>0.81±0.13</td>
<td>0.85</td>
</tr>
<tr>
<td><strong>postPTRA baseline</strong></td>
<td>0.96±0.15</td>
<td>1.01±0.03</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>postPTRA hyperemic</strong></td>
<td>0.99±0.03</td>
<td>1.01±0.03</td>
<td>0.09</td>
</tr>
</tbody>
</table>

*Man-Whitney test*
1 month BP response

PrePTRA Baseline FFR

PrePTRA Hyperemic FFR

FFR<0.8 predict BP improve in 87.5%

No response  Response  No response  Response
3 month BP response

PrePTRA Baseline FFR

PrePTRA Hyperemic FFR

FFR<0.8 predict BP improve in 85.7%
Summary

- Renal artery angioplasty could improve blood pressure in 61% of patients with indication by post PTRA 1 month
- No difference was found in clinical characteristics between blood pressure responder and nonresponder, even in real world renal vein concentration
- In lesions with prePTRA FFR < 0.8, renal artery angioplasty improved BP in 88%, 86% of patients 1, 3 month later respectively
Summary

• Baseline FFR rather than hyperemic is more useful to predict BP response

• The characteristics of patients showing BP response even with $\geq 0.8$ should be further investigated
Conclusion

PrePTRA FFR <0.8 can be a useful marker for selecting patients who would have BP response after renal artery angioplasty (86% positive predictability 3 month later). It can help avoiding unnecessary PTRA.
Thank you for your attention