Native Renal and Renal Transplants

Case Based Review

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THE PERIPHERAL EVENT OF THE YEAR
Native and Transplant Renal artery Interventions……

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Disclosure
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Consulting: Volcano Corp, Trireme Medical
Boston-Scientific, Abbott Vascular, Medtronic Vascular, Spectranetics
Overview

• Atherosclerotic Renal vascular disease
• Fibro-muscular Dysplasia
• Transplant Renal Artery Stenosis
• Summary
72 y/o WF with a Hx of HTN, CKD and pulmonic valve stenosis presents for eval of RAS.

- Pt with one year of increasing heart failure symptoms including shortness of breath and one week of increasing peripheral edema.

- She was admitted to the CCU with respiratory failure and pulmonary edema in the setting of hypertensive urgency and acute kidney injury requiring hemodialysis.

- Found to have labile BP requiring intermittent vasodilators and pressors.
Doppler Ultrasound
- The peak systolic velocities at the origins the right and left renal arteries and aorta were 370 cm/sec, 265 cm/sec, and 103 cm/sec, respectively. These velocities and the renal to aortic ratios are elevated, consistent with bilateral renal artery stenosis.
Diagnostic
Diagnostic
Right Renal Intervention

IVUS to mark ostium
Right Renal Intervention

Post - dilatation with NC balloons

Final Result
Left Renal Artery

Chocolate Balloon Angioplasty
Left Renal Artery

Final Result
Clinical Follow up

• Cr has decreased to 2.2 mg/dL
Revascularization for Atherosclerosis

- **CORAL**
  - 947 patients with RAS, HTN and/or chronic kidney disease
  - Palmaz genesis(Cordis) stent
  - Outcomes: Death, Stroke, MI, CHF, progressive renal dysfunction or HD

- **ASTRAL**
  - 806 patients with RAS, HTN and/or chronic kidney disease
  - Angioplasty only
  - Outcomes: Change in renal function

• SBP significantly improved with revascularization but clinical benefit unclear and inconsistent procedural techniques
• Excluded Fibromuscular dysplasia and patients with recurrent pulmonary edema and malignant HTN.
Revascularization has benefit in the right patients


Clinical Trial: CORAL

Relationship of Albuminuria and Renal Artery Stent Outcomes

Results From the CORAL Randomized Clinical Trial (Cardiovascular Outcomes With Renal Artery Lesions)

In patients with a low albumin/Cr, survival free of composite endpoints, Cardiovascular death, progressive renal insufficient and overall survival were improved by renal revascularization.
Evidence /Guidelines

• CHF / Flash Pulmonary Edema (Pickering Syndrome)
• Rapidly decreasing renal function /salvage
• Post transplant RAS
• Others:
  - RAS >80% with significant trans-lesional gradient
  - Young patients with >/= 3 Meds uncontrolled HTN
  - Truncal than ostial stenosis
  - Low urine albumin to creatinine ratio
Table 3. Summary of AHA/ACC Guideline recommendations for renal intervention.  

<table>
<thead>
<tr>
<th>Resistant Hypertension</th>
<th>Ischemic Nephropathy</th>
<th>Cardiac Disturbances</th>
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<tbody>
<tr>
<td>RAS with accelerated,</td>
<td>CKD with bilateral</td>
<td>Hemodynamically</td>
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<tr>
<td>resistant, or malignant</td>
<td>resistant significant</td>
<td>significant RAS</td>
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<tr>
<td>hypertension, hypertension</td>
<td>RAS or RAS of a solitary</td>
<td>(Class IIa, LOE B)</td>
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<tr>
<td>with unilateral small kidney,</td>
<td>kidney (Class IIa; LOE B).</td>
<td>with recurrent RAS</td>
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<tr>
<td>and hypertension with medication intolerance. (Class IIa, LOE B).</td>
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<td>with recurrent</td>
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<tr>
<td></td>
<td></td>
<td>unexplained heart failure or</td>
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<td></td>
<td></td>
<td>sudden explained pulmonary</td>
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<td></td>
<td></td>
<td>edema. (Class I, LOE B)</td>
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<tr>
<td></td>
<td>CKD with unilateral significant RAS (Class IIb; LOE B)</td>
<td>RAS with unstable angina. (Class IIa, LOE B)</td>
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<tr>
<td>Asymptomatic unilateral, bilateral, or a solitary viable kidney with hemodynamically significant RAS. (Class IIb; LOE C)</td>
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</tbody>
</table>

RAS = renal artery stenosis; CKD = chronic kidney disease; LOE = level of evidence
<table>
<thead>
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<th>Renal Interventional Scenarios</th>
<th>AUC</th>
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<tr>
<td>Cardiac Disease (Heart Failure, Hypertension, or Acute Coronary Syndrome [ACS]) with</td>
<td>9</td>
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<tr>
<td>Hypertension and moderate RAS with a resting translesional mean gradient of ( \geq 10 ) mmHg and/or severe RAS.</td>
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<tr>
<td>CKD IV bilateral moderate RAS with a resting translesional mean gradient of ( \geq 10 ) mmHg with kidney size ( \geq 7 ) cm in pole-to-pole length.</td>
<td>8</td>
</tr>
<tr>
<td>CKD IV and bilateral renal ischemia (unilateral severe RAS with a solitary kidney or bilateral severe RAS) without other explanation.</td>
<td>7</td>
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<tr>
<td>Resistant HTN (uncontrolled hypertension having failed maximally tolerated doses of at least three antihypertensive agents, one of which is a diuretic) and bilateral or solitary severe RAS.</td>
<td>7</td>
</tr>
<tr>
<td>Recurrent CFS with unilateral moderate RAS with a resting translesional mean gradient of ( \geq 10 ) mmHg.</td>
<td>6</td>
</tr>
<tr>
<td>CKD class II with bilateral severe RAS.</td>
<td>6</td>
</tr>
<tr>
<td>CKD class I stable for 1 year, with bilateral severe RAS.</td>
<td>5</td>
</tr>
<tr>
<td>Resistant HTN (uncontrolled hypertension having failed maximally tolerated doses of at least three antihypertensive agents, one of which is a diuretic) with severe unilateral RAS and anatomic anomalies or high-risk lesion (early bifurcation, small vessel, severe concentric calcification, and severe aortic stenosis or mural thrombus).</td>
<td>5</td>
</tr>
<tr>
<td>Resistant HTN (uncontrolled hypertension with failure of maximally tolerated doses of at least three antihypertensive agents, one of which is a diuretic, or intolerance to medications) and unilateral moderate (50% to 70%) RAS with a mean translesional gradient of ( &lt; 10 ) mmHg.</td>
<td>4</td>
</tr>
<tr>
<td>CKD III progressing to CKD IV over 6 months with solitary severe RAS, with kidney size ( &lt; 7 ) cm in pole-to-pole length.</td>
<td>3</td>
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<tr>
<td>Resistant HTN (uncontrolled hypertension having failed maximally tolerated doses of at least three antihypertensive agents, one of which is a diuretic) with unilateral chronic total occlusion of the renal artery.</td>
<td>3</td>
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<tr>
<td>BP ( \geq 150/100 ) mmHg on two medications (one a diuretic) with severe unilateral RAS.</td>
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<tr>
<td>BP ( \geq 150/100 ) mmHg on a single anti-hypertensive medication with severe unilateral RAS.</td>
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<tr>
<td>Solitary severe RAS with controlled BP and normal renal function.</td>
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<tr>
<td>Bilateral severe RAS with controlled BP and normal renal function.</td>
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<td>CKD III progressing to CKD IV over 6 months with unilateral severe RAS with kidney size ( &lt; 7 ) cm in pole-to-pole length.</td>
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<td>CKD class II with unilateral severe RAS.</td>
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<tr>
<td>Bilateral severe RAS with controlled BP and normal renal function.</td>
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<tr>
<td>Bilateral severe RAS with chronic end-stage renal disease on hemodialysis ( \geq 3 ) months.</td>
<td>2</td>
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<tr>
<td>Unilateral severe RAS with controlled BP and normal renal function.</td>
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</table>
65-year-old white female with a history of CML, labile hypertension, congestive heart failure and history of fibro-muscular dysplasia now presenting with severe headaches and hypertension requiring escalating doses of clonidine.

- 08/2014 presented to OSH with malignant hypertension, unstable angina, and congestive heart failure.
- The patient was found to have bilateral renal artery stenosis and underwent intervention with placement of bare metal stents in the bilateral renal arteries.
- 03/2015 when she presented with malignant hypertension and was found to have bilateral restenosis of her renal stents. She underwent successful intervention with Resolute DES x2.
Right Renal Artery

Chocolate Balloon Angioplasty

In.Pact Admiral DEB
Left Renal Artery

Chocolate Balloon Angioplasty

In.Pact Admiral DEB
Final result
Clinical Follow up

- Cr has decreased to normal value
- BP now in the 140-150’s systolic on home BP log.
- Headaches, clonidine use and dyspnea have markedly improved.
- She is scheduled to return in 6 months for repeat renal angiogram
Fibromuscular Dysplasia (FMD)

• First described by Leadbetter and Burkland in 1938.
• FMD affects mid/distal arterial segments
• 3 distinct types based on involved arterial layer:
  • Medial (most common; “beads on a string”, perimedial subtype)
  • Intimal (10% of FMD, focal concentric stenosis that are long and smooth)
  • Adventitial (very rare, focal, sharply tubular stenosis)

Angioplasty is mainstay of treatment

53 y/o WM with a Hx of Autosomal dominant polycystic kidney disease and renal transplantation 6 months prior presents for evaluation of TRAS

- Pt presented 1 month prior with acute kidney injury and biopsy negative for rejection.
- His kidney function continued to decline and he was initiated on HD
- He was referred for angiogram to rule transplant renal artery stenosis
Diagnostic
Intervention

Herculink Elite Stents
Clinical Follow up

• His urine output increased that day and he was off HD by discharge

• He presented with Cr 1.67mg/dl 1 year later but with poorly controlled HTN
43-year-old white male with a history of end-stage renal disease secondary to possible IgA nephropathy, status-post deceased donor kidney transplant in 2001, hypertension, presents with severe malignant hypertension, and acute on chronic kidney injury requiring hemodialysis.

- Also with right lower extremity claudication
- Renal duplex ultrasound with high grade lesion in the mid transplant renal artery and was referred for a renal angiogram.
Intervention

Semi-Compliant Balloon Angioplasty both limbs
Intervention

IVUS showed fibrotic hyperplasia

AngioSculpt Balloon Angioplasty
Intervention

Rewired and angioplasty
Final Result
...Fix that Iliac

8.0 Express LD Stent

Final Result
Clinical Follow up

• Cr 3 years later is 1.67mg/dL and is still off HD
• His BP is under excellent control
Stenosis in Transplant Renal Arteries (TRAS)

- TRAS prevalence of upwards of 23% of renal allograft recipients.
- Risk Factors: CMV+, DGF, age>50, cadaveric……..
- Can manifest as graft dysfunction or resistant HTN
- 4 primary causes:
  - Pre-anastomotic (atherosclerosis, vessel clamp injury)
  - Anastomotic (suture, perfusion injury, intimal)
  - Post-anastomotic (intimal hyperplasia, immune mediated, twist, kink or compression)
  - Distal (rejection)
- Percutaneous revascularization has become preferred management given the complexity of re-operation.

Conclusions

• Revascularization in atherosclerotic renal artery stenosis still has tremendous value in the right patients.

• Specialty balloons are extremely useful in treating many forms of stenosis in the renal arteries.

• Percutaneous revascularization of transplant renal artery stenosis (and iliac stenosis) can be graft saving.

• IVUS helps improve renal interventions and can markedly reduce IV contrast use.
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