Intravascular Lithotripsy for Treatment of Infrapopliteal Lesions

Results from the Disrupt PAD III Observational Study

George L. Adams
MD, MHS, MBA, FACC, FSCAI
UNC REX Healthcare
Raleigh, North Carolina USA
Disclosure

Speaker name: George Adams, MD

I have the following potential conflicts of interest to report:

✓ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☐ I do not have any potential conflict of interest
Endovascular Treatment for Calcified PAD

• Infrapopliteal arterial calcium
  • Medial calcification is more prevalent in infrapopliteal arteries
  • Contributes to wall stiffness, vessel recoil and restenosis
  • Leads to increased periprocedural complications

• Percutaneous transluminal angioplasty (PTA) of calcified infrapopliteal lesions is associated with sub-optimal procedural outcomes, results in early recoil, and may contribute to restenosis.

• While promising results with IVL have been reported in a small pilot study, real world evidence from a larger cohort is lacking.

Rocha-Singh et al., Catheter Cardiovas Interv 2014; Walker et al., J. Vasc Surg 2015
Intravascular Lithotripsy

- Delivers 1 pulse/sec with an effective pressure of ~50 atm
- Low balloon inflation pressure
- Fractures both superficial and deep calcium

Deliver catheter and inflate to low pressure

Generate sonic pressure waves using lithotripsy

Crack calcium

Safely expand the vessel

Pre-IVL Treatment*

Post-IVL Treatment*

*Micro-CT scan analysis: R. Virmani, CV Path Institute
Disrupt PAD III Observational Study

Prospective, multicenter, single-blind, observational study
NCT02923193

Planned enrollment: 1,500 patients
Objective: Assess ‘real-world’ peri-procedural outcomes of IVL for treatment of calcified, stenotic, peripheral arteries

**PAD III OS Sub-study:**

**IVL treatment of calcified infrapopliteal arteries**
Heavily calcified *de novo* infrapopliteal lesions
IVL +/- adjunctive therapy*
July 2018 – Aug 2020
N = 101 patients; 114 BTK lesions; 15 global sites

Sub-study objective: Assess ‘real world’ peri-procedural outcomes of S⁴ IVL treatment of calcified BTK lesions†

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Length (mm)</th>
<th>Pulses/Cycle</th>
<th>Max Pulse Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 - 4.0</td>
<td>40</td>
<td>20</td>
<td>160</td>
</tr>
</tbody>
</table>

*No per protocol treatment algorithm; adjunctive therapy use per operator’s discretion. †Angiographic core-lab assessment
### Baseline Characteristics

**Characteristic** | **Patients N=101**
--- | ---
Age | 72.5 ± 9.7
Male | 75.2%
Hypertension | 97.0%
Hyperlipidemia | 82.2%
Diabetes Mellitus | 74.3%
Current Smoker | 18.8%
Prior MI | 25.7%
Prior CABG | 49.5%
Prior Stroke | 14.9%
Renal Insufficiency | 48.5%
On Dialysis | 23.8%
ABI | 0.81 ± 0.33

**Rutherford Category N=101 Patients**

- RC 6: 45%
- RC 5: 30%
- RC 4: 14%
- RC 3: 30%
- RC 2: 1%
- RC 1: 1%

70% of patients with critical limb ischemia
# Lesion Characteristics
(Core Lab Adjudicated)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Lesions N=114</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesions per Patient</td>
<td>1.1 ± 0.3</td>
</tr>
<tr>
<td>Reference Vessel Diameter, mm</td>
<td>3.1 ± 0.8</td>
</tr>
<tr>
<td>Minimum Lumen Diameter, mm</td>
<td>0.5 ± 0.6</td>
</tr>
<tr>
<td>Diameter Stenosis, %</td>
<td>85% ± 15%</td>
</tr>
<tr>
<td>CTO, %</td>
<td>35.1%</td>
</tr>
<tr>
<td>Lesion Length, mm</td>
<td>65 ± 55</td>
</tr>
<tr>
<td>Calcified Length, mm</td>
<td>53 ± 43</td>
</tr>
<tr>
<td>Moderate-Severe Calcification Site-Reported</td>
<td>100%</td>
</tr>
<tr>
<td>Core Lab Adjudicated</td>
<td>69.3%</td>
</tr>
<tr>
<td>Eccentric</td>
<td>14.0%</td>
</tr>
</tbody>
</table>

## Lesion Location
(N=114)

- Posterior Tibial 16%
- Anterior Tibial 34%
- Peroneal 17%
- Tibio-peroneal Trunk 33%
Treatment with the S$^4$ IVL catheter resulted in marked improvement in diameter stenosis.
Procedural Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients N=101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure Time, min</td>
<td>88 ± 46</td>
</tr>
<tr>
<td>Contrast Volume, ml</td>
<td>147 ± 77</td>
</tr>
<tr>
<td>Fluoroscopy Time, min</td>
<td>21 ± 11</td>
</tr>
<tr>
<td>Embolic Protection</td>
<td>3.0%</td>
</tr>
<tr>
<td>Pre-Dilatation</td>
<td>27.7%</td>
</tr>
<tr>
<td>Post-IVL Dilatation</td>
<td>50.5%</td>
</tr>
<tr>
<td>IVL Catheters</td>
<td>1.1 ± 0.3</td>
</tr>
<tr>
<td>IVL Pulses</td>
<td>139 ± 54</td>
</tr>
<tr>
<td>Stand-Alone IVL Therapy*</td>
<td>77%</td>
</tr>
<tr>
<td>IVL + Adjunctive Ca++ Modifying Therapy*</td>
<td>23%</td>
</tr>
</tbody>
</table>

Adjunctive Therapy N=101

- Sp. Balloon: 8%
- Atherectomy: 16%
- DCB: 15%
- Stent: 11%

Multiple adjunctive therapies used in 9 subjects

*IVL stand-alone therapy includes pre- or post-dilatation with PTA; Calcium-modifying therapy includes specialty balloons and/or atherectomy. DCB and/or stents used in both groups.
†9/11 stents placed in CTO cases
Angiographic Outcomes
(Core Lab Adjudicated)

**Diameter Stenosis**

<table>
<thead>
<tr>
<th></th>
<th>Pre-procedure</th>
<th>Post-IVL</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>114</td>
<td>98</td>
<td>96</td>
</tr>
<tr>
<td>Diameter Stenosis (%)</td>
<td>83%</td>
<td>28%</td>
<td>23%</td>
</tr>
</tbody>
</table>

**Complications**

<table>
<thead>
<tr>
<th></th>
<th>Post-IVL N=98</th>
<th>Final N=96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissections D-F</td>
<td>3.1%†</td>
<td>0%</td>
</tr>
<tr>
<td>Perforation</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Distal Emboli</td>
<td>1.0%</td>
<td>0%</td>
</tr>
<tr>
<td>Slow Flow/ No Reflow</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Abrupt Closure</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

* Comparison across all time points: p<0.001; †3 events, all occurred in CTO lesions
Conclusions

• This sub-study from the ‘real world’ Disrupt PAD III Observational Study represents the largest cohort for IVL treatment of heavily calcified infrapopliteal arteries and the initial experience using the Shockwave S⁴ IVL catheter

• Acute outcomes following IVL treatment demonstrated:
  • Significant reduction in diameter stenosis immediately following IVL treatment
  • Minimal vascular complications, with no serious angiographic complications at the end of the procedure

• Treatment approach was per operator’s discretion in this ‘real world’ study
  • Ca++ modifying adjunctive therapy was used in 23% of cases in this initial S⁴ IVL BTK treatment experience
  • 95% of cases were performed in the U.S. - data may be more reflective of U.S. current practice

• Future studies with longer-term follow-up are needed to understand the durability of IVL treatment in calcified infrapopliteal arteries