Rotational and Aspiration Atherectomy in Treating in-Stent Restenosis of Femoropopliteal Arteries: 
One-Year Results of the JETSTREAM-ISR Feasibility Study

Nicolas W Shammas, MD, MS, FACC, FSCAI
Research Director,
Midwest Cardiovascular Research Foundation
Clinical Adjunct Professor of Medicine, Univ of Iowa
Interventional Cardiology,
Cardiovascular Medicine, PC
Disclosure

Speaker name: Nicolas W Shammas, MD, MS, FACC, FSCAI

I have the following potential conflicts of interest to report:

- Consulting: Boston Scientific, Gilead
- Trainer: Boston Scientific (Jetstream), Covidien (RF)
- Speaker Bureau: Boston Scientific, The Medicines Co, Novartis, Merck, Boehringer Ingelheim, BMS/pfizer, AZ,
- Other(s): Research and educational grants from Boston Scientific, CSI, Bard. Steering Committee: JET, Endomax
- National/Co-National PI: Jet-ISR, Safe-DCB, JetStream-ISR
Scope of the Problem: Femoropopliteal In-Stent Restenosis (FP-ISR)

- Fempop ISR occurs in 20-30% of stented patients at 1 year and up to 49% at 2 years
- Treatment of FP ISR with POBA carries a high rate of TLR at one year (37-47%) (bailout stent included as TLR) and reduced patency rates (28% to 37%)
- New therapies including laser atherectomy, Viabhan graft stenting, and DCB have shown superiority over POBA in treating FP ISR
- It is estimated that the incidence of FP ISR is over 120,000 cases per year in the US only
Pathway PV Atherectomy System in Femoropopliteal In-Stent Restenosis

- 33 patients with FP ISR were enrolled at 5 study sites.
- Primary endpoint: 30-day serious adverse event (SAE) rate.
  13 patients had follow-up examinations with duplex.
- 39.4% DM.

RESULTS:
- 40 lesions, mean lesion length of 85.7 mm, CTO 20%, infrapopliteal lesions 5%
- 40% procedural success with atherectomy alone
- Freedom from device-related SAEs was 100%
- Primary patency was 64% at 6 month, 33% at 1 year.
Jetstream XC Catheters
Expandable-Blade Technology

2.1 / 3.0mm Catheter
(OTW, 135cm shaft)
- 2.1mm Blades-Down
- 3.0mm Blades-Up

2.4 / 3.4mm Catheter
(OTW, 120cm shaft)
- 2.4mm Blades-Down
- 3.4mm Blades-Up

Expandable-Blade Technology
 Allows for sizing flexibility - Treat both the SFA & Popliteal with one catheter
Pathway vs JetStream XC

**Pathway**
- Aspiration port integrated into the distal cutter
- No macerator
- 8 F compatible
- 10-flute design distal cutter

**JetStream**
- Aspiration port moved proximal to cutting blades with **11% increase in aspiration efficiency**
- Macerator added. **10% increase in aspiration efficiency**
- 7F-compatible
- 5-flute distal cutter. **30% larger lumen**
- Increase torque with **54% increase in cutting efficiency**
Porcine overstretched injury model of Femoral Artery ISR

Partial overlapping stents, fully overlapping stents, Stent across branches

Stents fully expanded

JetStream ISR Feasibility Study

**DESIGN:** Prospective, feasibility registry at 2 US centers, evaluating JetStream XC atherectomy (JS) in treating Femoropopliteal in-stent restenosis (FP ISR)

**OBJECTIVE:** To evaluate efficacy and safety of JS with adjunctive PTA (JS+PTA) and assess stent-device interaction using Angiographic Core Lab adjudication

**PRINCIPAL INVESTIGATOR**
Nicolas W Shammas, MD, MS

**SUBINVESTIGATOR**
Subhash Banerjee, MD

**Angiographic Core Laboratory**
Beth Israel Deaconess Med Ctr
Jeffrey Popma, MD

29 patients (32 limbs) enrolled at 2 clinical sites between October 2012 and August 2014 in the United States

32 limbs crossed intraluminally/JS+PTA

Primary Efficacy/Safety endpoints at 1 mo (n=32)

Primary Safety endpoint and TLR at 6 months (n=27 pts; n=29 limbs)

1 patient died (2 limbs)
1 patient withdrew (1 limb)

Stent Integrity evaluation per core lab (n=24)

Secondary effectiveness endpoint TLR at 1 year (n=27 pts; n=29 limbs)
Study Endpoints

Efficacy Endpoints

• Acute Procedural Success (primary endpoint)
  – Less or equal 30% residual narrowing with no serious adverse events
• Acute Device Success (secondary endpoint)
  – Less or equal 50% residual narrowing after JS alone

Safety Endpoints

• Major Adverse Events (primary endpoints):
  – In-hospital: Treated DE, Perforation, Major Bleeding, death, amputation, acute closure, access complication, Acute renal failure, adverse stent-device interaction (fracture/deformity)
  – 30 days and 6 months: Death, unplanned amputation, freedom from clinically driven TLR (recurrence of symptoms with abnormal ABI or confirmed loss of patency angiographically >50% lesion), Stent deformity and fracture (6 months)
  – TLR at 1 year (secondary endpoints)
### Inclusion and Exclusion Criteria

**— Inclusion Criteria**

- Femoropopliteal lesions with in-stent restenosis of \( \geq 50\% \)
- Rutherford-Becker category of 1-5
- One patent infrapopliteal distal runoff
- Vessel Diameter of \( \geq 5 \) mm
- No lesion length limit

**— Exclusion Criteria**

- Not able to give informed consent
- Unable to take antiplatelet drugs post procedure
- \( \text{Cr} \geq 2.5 \) mg per dl
- Planned surgical or endovascular procedure within 15 days of the index procedure
- Stent fractures Class III and IV
## Clinical and Angiographic Variables

<table>
<thead>
<tr>
<th>Demographic and Clinical</th>
<th>Angiographic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (mean) yrs</strong></td>
<td><strong>Treated length mm</strong></td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td><strong>Lesion Diam. mm</strong></td>
</tr>
<tr>
<td><strong>Hyperlipidemia</strong></td>
<td><strong>Run-off vessels</strong></td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td><strong>Stenosis Severity %</strong></td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td><strong>Stenosis post JS %</strong></td>
</tr>
<tr>
<td><strong>Current smoking</strong></td>
<td><strong>Stenosis post PTA %</strong></td>
</tr>
<tr>
<td><strong>Prior index lesion ISR</strong></td>
<td><strong>TASC C/D</strong></td>
</tr>
<tr>
<td><strong>Prior PCI</strong></td>
<td><strong>Blades Up run time min</strong></td>
</tr>
<tr>
<td><strong>Rutherford Category</strong></td>
<td><strong>Blades Down run time min</strong></td>
</tr>
<tr>
<td>0</td>
<td><strong>Treatment Interval min</strong></td>
</tr>
<tr>
<td>3</td>
<td><strong>JS XC 2.4</strong></td>
</tr>
<tr>
<td>4</td>
<td><strong>JS XC 2.1</strong></td>
</tr>
<tr>
<td>5</td>
<td><strong>Mean Volume Aspirate ml</strong></td>
</tr>
<tr>
<td><strong>On Aspirin</strong></td>
<td><strong>Lesions ≥ 30 cm/CTO</strong></td>
</tr>
<tr>
<td>90.6 %</td>
<td><strong>Stent Fracture 1&amp;2</strong></td>
</tr>
<tr>
<td><strong>On ADP-receptor antagonist</strong></td>
<td></td>
</tr>
<tr>
<td>75 %</td>
<td></td>
</tr>
</tbody>
</table>
### Intraprocedural Outcomes/Complications

<table>
<thead>
<tr>
<th>Device Success</th>
<th>75.9 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual Stenosis ≤30% (post adjunctive balloon)</td>
<td>100%</td>
</tr>
<tr>
<td>Procedural Success (no SAE)</td>
<td>90.6 %</td>
</tr>
<tr>
<td>Stenting post JS/PTA (3/32)</td>
<td>9.4%</td>
</tr>
<tr>
<td>Bail out stenting (2/32)</td>
<td>6.3%</td>
</tr>
<tr>
<td>Treated Distal Embolization</td>
<td>9.4%</td>
</tr>
<tr>
<td>No Filter</td>
<td>6.3%</td>
</tr>
<tr>
<td>Spider Filter</td>
<td>3.1%</td>
</tr>
<tr>
<td>Nav-6 Filter</td>
<td>0%</td>
</tr>
<tr>
<td>New Stent Fracture or Deformities (Core Lab)(n=24)</td>
<td>0%</td>
</tr>
</tbody>
</table>

No Abrupt Closure, acute thrombosis, perforation, major bleeding
JetStream ISR patient:
Baseline, postJS and post adjunctive balloon angioplasty
### Safety Endpoints:
#### 30 d, 6 mo, 1 yr

<table>
<thead>
<tr>
<th>Event</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLR/TVR 30 days</td>
<td>0 %</td>
</tr>
<tr>
<td>Death 30 days</td>
<td>0 %</td>
</tr>
<tr>
<td>Amputation 30 days</td>
<td>0 %</td>
</tr>
<tr>
<td>Death 6 months (non vascular)</td>
<td>3.4 %</td>
</tr>
<tr>
<td>Freedom from TLR 6 mo</td>
<td>86.2 %</td>
</tr>
<tr>
<td>(not including intraprocedural bail out stenting as TLR)</td>
<td></td>
</tr>
<tr>
<td>Freedom from TLR 6 mo</td>
<td>79.3 %</td>
</tr>
<tr>
<td>(including intraprocedural bail out stenting as TLR)</td>
<td></td>
</tr>
<tr>
<td>Patency 6 mo</td>
<td>72 %</td>
</tr>
<tr>
<td>New Stent Fracture or Deformities (Core Lab) at 6 mo (n=24)</td>
<td>0 %</td>
</tr>
<tr>
<td>Amputation 6 mo</td>
<td>0 %</td>
</tr>
<tr>
<td>Freedom from TLR 1 yr</td>
<td>58.6 %</td>
</tr>
<tr>
<td>(bailout stent not TLR)</td>
<td></td>
</tr>
<tr>
<td>Freedom from TLR 1 yr</td>
<td>48.3 %</td>
</tr>
<tr>
<td>(bail out stent as TLR)</td>
<td></td>
</tr>
</tbody>
</table>
Freedom from TLR (censored) at 1 year (excluding bail out stenting as TLR)
FP ISR treatment: Summary of Data
Bail out stent not included as TLR

JETSTREAM™ Atherectomy System

NOW WITH CE MARK FOR IN-STENT RESTENOSIS

Proven in Femoropopliteal ISR Lesions

© 2016 Boston Scientific Corporation or its affiliates. All rights reserved. PI-368205-AA JAN16
# JET-ISR Registry Synopsis

<table>
<thead>
<tr>
<th>JET-ISR Registry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>Evaluate use of Jetstream Atherectomy (JS) and adjunctive balloon angioplasty (JS+PTA) in the treatment of femoropopliteal ISR lesions in subjects with claudication or limb ischemia (Rutherford clinical category (RCC) of 2-4) (lesion length ≥ 4 cm).</td>
</tr>
</tbody>
</table>
| **Primary Investigator** | Nicolas W Shammas, MD, MS, FACC, FSCAI  
Subhash Banerjee, MD, FACC, FSCAI |
| **Study Design**  | A prospective, multicenter, single arm study  
Comparitor arm is historic data from plain old balloon angioplasty derived from a Meta-analysis of the 3 published randomized trials |
| **Subjects**      | 140 subjects treated with JS+PTA |
| **Investigational Centers** | Up to 14 site in the U.S. |
| **Primary Efficacy Endpoint** | Target Lesion Revascularization (TLR) at 6 months  
  • TLR defined as retreatment of the index lesion (extended 1 cm proximal and distal to the lesion) at 6 months  
  For the primary endpoint, intra-procedural bail out stenting of the index lesion is considered meeting a TLR endpoint. (ITT analysis) |
| **Primary Safety Endpoint** | Major Adverse Events (MAE) at 30 days:  
  • Unplanned amputation  
  • Total mortality  
  • TLR at 30 days (TLR includes bail out stenting) |
<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Subject presents with a Rutherford Classification of 2-4 and has symptoms of rest limb pain or claudication.</td>
<td>• Diagnosed with chronic renal failure or has a creatinine level &gt; 2.5 mg/dl and is not on chronic dialysis.</td>
</tr>
<tr>
<td>• Target lesion(s) must be viewed angiographically and have ≥50% stenosis.</td>
<td>• Known allergy to heparin, ASA, Plavix.</td>
</tr>
<tr>
<td>• The main target vessel reference diameter must be ≥ 5 mm and ≤ 7 mm</td>
<td>• History of bleeding disorders or platelet count &lt; 80,000 cells/ml.</td>
</tr>
<tr>
<td>• One patent distal run-off vessel with &lt;70% disease and with brisk flow is required.</td>
<td>• Experiences ongoing cardiac problems (e.g., cardiac arrhythmias, congestive heart failure exacerbation, myocardial infarction, etc.) that, per the investigator, would not make the subject an ideal candidate for study procedures.</td>
</tr>
<tr>
<td>• Intraluminal crossing of the lesion. If this is not certain, IVUS may be used to verify this per operator’s discretion</td>
<td>• CVA or TIA within 4 weeks prior to JetStream procedure.</td>
</tr>
<tr>
<td>• Patient has signed approved informed consent.</td>
<td>• Anticipated life span of less than 12 months.</td>
</tr>
<tr>
<td></td>
<td>• Evidence of intracranial or gastrointestinal bleeding within the past 3 months.</td>
</tr>
<tr>
<td></td>
<td>• Severe trauma, fracture, major surgery or biopsy of a parenchymal organ within the past 14 days.</td>
</tr>
<tr>
<td></td>
<td>• Planned surgical intervention or endovascular procedure ≤ 30 days after the index procedure.</td>
</tr>
<tr>
<td></td>
<td>• Use of another debulking device during the index procedure prior to the Jetstream XC System.</td>
</tr>
<tr>
<td></td>
<td>• Use of another debulking device after the Jetstream XC system.</td>
</tr>
</tbody>
</table>
JET-ISR Registry
Follow-up

Index Procedure
For all enrolled subjects

Predischarge Follow-up
Prior to discharge or within 5 days after index procedure

30-day Follow-up Visit
30-45 days after index procedure

6-Month Follow-up Visit
150-210 days after index procedure

12-Month Follow-up
320-410 days after index procedure
Conclusions

• JS atherectomy is effective and safe in this feasibility prospective registry in treating FP ISR:
  – In long lesions averaging 19.5 cm in length, CTO 25%
  – With high procedural (100% < 30% residual) and device success (75.9% < 50% residual)
  – No stent-device interaction by adjudicated Angiographic Core Lab (including in Class 1 and 2 fractures and stent overlap)
  – TLR rates in the same range as published literature for the laser

• Combining JS atherectomy with Drug Coated Balloons in treating FP ISR may be a promising strategy that needs to be tested in randomized trials
Acknowledgement

Gail A Shammas, RN, BSN
Subhash Banerjee, MD
Jeffrey J Popma, MD
Atif Mohammad, MD
Michael Jerin, PhD
Gary Jarvis, MS
Midwest Cardiovascular Research Foundation
Beth Israel Deaconess Med Ctr
Trinity Medical Center, Bettendorf, IA
VA Medical Center, Dallas, Tx
Thank you
Rotational and Aspiration Atherectomy in Treating in-Stent Restenosis of Femoropopliteal Arteries: One-Year Results of the JETSTREAM-ISR Feasibility Study

Nicolas W Shammas, MD, MS, FACC, FSCAI
Research Director,
Midwest Cardiovascular Research Foundation
Clinical Adjunct Professor of Medicine, Univ of Iowa
Interventional Cardiology,
Cardiovascular Medicine, PC