Technique and outcomes of Laser-Atherectomy for calcified femoro-popliteal lesions

Reza Ghotbi
Helios Klinikum München West
Akademisches Lehrkrankenhaus der LMU München
Disclosure

Speaker name:

............R. Ghotbi.................................................................

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)

☐ X I do not have any potential conflict of interest
1917, Einstein established the theoretical foundations for the laser.

1960, Ali Javan constructed the first gas laser that was capable of continuous operation in the infrared.

1963, McGuff first used Laser for the experim. ablation of atherosclerotic plaques

1983, first clinical applications for PAD by Ginsburg.

They all use the principle of **selective photothermolysis**:

> “Getting the **correct amount** of laser energy with the **correct wavelength** to the **correct tissue** to damage or destroy only that tissue, and nothing else!”
UV Lasers (10 to 400 nanometer)...

- Carry photon energies high enough to break molecular bonds (covalent)
- Have shallow absorption depth, <100 microns
- Reduces energy required to cut
- Reduces collateral tissue effects
- Allows coupling into fiber optics and delivery to the end of the catheter
- The very short actual working time, 2 µm vaporized during each pulse, preventing thermal damage of arterial structures.
The size of the debris formed by excimer laser ablation of tissue is very small.

The debris is mostly cellular and subcellular components.
Erythrocyt = 7.5 micron, Plättet= 1.5 - 3.5 micron
Particles of this size generally do not cause embolization
Atherectomy Devices - Point of ablation comparison

- Works at the tip
- No mechanical moving parts

- Turbo-Elite™ (Spectranetics)

- Turbo-Tandem™ (Spectranetics)

- Silver Hawk™ (Medtronic)

- Pantheris™ (Avinger)

- Rotarex™ (Straub)

- Jetstream™ (Boston Scientific)

- Phoenix™ (Volcano)
Laser atherectomy changes vessel compliance

As shown by IVUS core lab, of the lumen area increase post laser:

- 45% of the gain came from plaque removal
- 55% came from vessel compliance expansion
Technique; SIZE of the Laser Catheter

The size of the laser catheter should not exceed 2/3 of the reference vessel diameter.

<table>
<thead>
<tr>
<th>Catheter Size</th>
<th>Approximate Vessel Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9mm</td>
<td>≥ 1.4mm</td>
</tr>
<tr>
<td>1.4mm</td>
<td>≥ 2.1mm</td>
</tr>
<tr>
<td>1.7mm</td>
<td>≥ 2.6mm</td>
</tr>
<tr>
<td>2.0mm</td>
<td>≥ 3.0mm</td>
</tr>
<tr>
<td>2.3mm</td>
<td>≥ 3.5mm</td>
</tr>
<tr>
<td>2.5mm</td>
<td>≥ 3.8mm</td>
</tr>
</tbody>
</table>

In situations where a conservative approach is desired, size laser catheter to approximately ½ vessel size.
Technique; Saline Infusion

In order to obtain an *optimal contact* between catheter tip and lesion it is mandatory to implement the saline infusion protocol.

20 ml saline bolus after each contrast injection

15 ml saline flush during every laser activation (5 sec)

Removes Contrast from system

Eliminates Blood from lasing field

Reduced un-expected dissections
Technique: Slow Advancement is KEY!

FAST ADVANCEMENT
Technique; Slow Advancement is KEY!

FAST ADVANCEMENT

SLOW ADVANCEMENT
Technique; Slow Advancement is KEY!

FAST ADVANCEMENT

SLOW ADVANCEMENT

less than 1 mm per second  \[\Rightarrow\]  6 cm lesion = 60 seconds = minimum of 1 minute to cross
Complex, Heterogeneous Morphology

- Composition ranges from soft necrotic core to hardened calcium crystal
- Dominated by soft- to moderate morphologies
  - Fibrocalcific and compact calcium = 15-25% of average PAD lesion

References:

Restenosis; Lesions composition

Different Morphology of restenisis

- Lesions have a significant hydrated collagen matrix component
- Water is attracted to voids in the cellular structure

<table>
<thead>
<tr>
<th>Degree of Intimal Calcium</th>
<th>De Novo - No Thrombus</th>
<th>De Novo - With Thrombus</th>
<th>Restenotic</th>
<th>All Lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Intimal Calcium</td>
<td>7.0%</td>
<td>11.0%</td>
<td>45.0%</td>
<td>63.0%</td>
</tr>
<tr>
<td>MILD Calcium</td>
<td>6.0%</td>
<td>7.5%</td>
<td>2.0%</td>
<td>15.5%</td>
</tr>
<tr>
<td>MODERATE Calcium</td>
<td>6.0%</td>
<td>5.0%</td>
<td>2.0%</td>
<td>13.0%</td>
</tr>
<tr>
<td>SEVERE Calcium</td>
<td>4.0%</td>
<td>3.5%</td>
<td>1.0%</td>
<td>8.5%</td>
</tr>
<tr>
<td>TOTAL Lesion Type</td>
<td><strong>23.0%</strong></td>
<td><strong>27.0%</strong></td>
<td><strong>50.0%</strong></td>
<td></td>
</tr>
</tbody>
</table>

> 75% have no to mild intimal calcium

Inoue (2002). J of Vasc Surg; 35: 672-678
chose fluence and pulse rate according to lesion morphology

**Fluence (mJ/mm²) & Repetition Rate (Hz)**
Renaissance of old and new Atherctomy procedures, that combined with DEB may provide an Advantage, primarily due to antiproliferative effect of pactitaxel.

DEB is simply not a recanalisation rather than an Application tool!

Lumen preparation of the recanalized vessel & Application technique are important Aspects.
(Laser) atherectomy Studies

2. Kenagy RD et al. (2005). J Histochem Cytochem. 53(1); 131-140
9. D015794-01, Step-By-Step Technique Laser Atherectomy for a refractory Occlusion
Laser Atherectomy effectively ablates and vaporizes a range of morphologies within denovo and restenotic lesions.

Initial pre-clinical and clinical evidence suggest Laser + DCB as an effective combination to achieve superior and more durable results while avoiding additional stent layers.

**Comparison of Angioplasty/Drug Coated Balloon/Laser + Drug Coated Balloon for Femoropopliteal Artery In-stent Restenosis (INTACT)**

*This study is not yet open for participant recruitment. (see Contacts and Locations)*

**Sponsor:**
University Hospital, Bordeaux

**Information provided by (Responsible Party):**
University Hospital, Bordeaux

**ClinicalTrials.gov Identifier:**
NCT02599389

First received: November 5, 2015
Last updated: NA
Last verified: October 2015
History: No changes posted
20th Anniversary
Wednesday December 13
Helios Klinikum Mü West
7 pm
Steinerweg 5
München