Declaration of conflict of interest
Impact of the Angiosome Concept for Endovascular Therapy in Patients With Critical Limb Ischemia Due to Isolated Below-The-Knee Lesions

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Revascularization in patients with critical limb ischemia (CLI) is used for primarily preventing limb loss, including major amputations, improving quality of life, and prolonging survival.

The angiosome concept, as introduced by Ian Taylor, separates the body into distinct three-dimensional blocks of tissue fed by “source” arteries.

There is increasing evidence that the angiosome concept is clinically useful in bypass surgery and especially in endovascular therapy (EVT) for limb salvage in CLI patients.
Anterior Tibial Artery Angiosomes

- Popliteal Artery
- Dorsalis Pedis Artery
Posterior Tibial Artery Angiosome

- Lateral Planter Artery
- Medial Planter Artery
- Posterior Tibial Artery
- Calcaneal Branch
- Medial Planter Artery
- Calcaneal Branch
Peroneal Artery Angiosomes

Calcaneal Branch of PA

Peroneal Artery
Objective

We sought to assess one-year EVT outcomes in patients with CLI, due to isolated BTK lesions, utilizing the angiosome concept.
Study Population
56 limbs in 47 consecutive patients with ischemic ulceration (Rutherford Class 5 or 6).

All study patients presented with CLI due to isolated BTK lesions and underwent successful EVT (balloon angioplasty) revascularization.

Success was defined as obtaining ‘flow through’ with at least one vessel to the pedal arch.
Methods

1. We first confirmed the locations of the ischemic ulceration.

2. We determined the angiosome-based target lesion locations via digital subtraction angiography (DSA).

3. If wounds expanded over more than one artery’s area, all supplying arteries were treated.

4. We evaluated whether angiosome-based straight lines were obtained or not by DSA.

5. All EVT procedures were up to the respective operator’s discretion.
Definitions

Direct Group:
Angiosome-based straight lines were obtained.

Indirect Group:
Angiosome-based straight lines were not obtained; however, non-angiosome-based flows were established.

Evaluation

Major Adverse Limb Events (MALE) one year after EVT (Major Amputation, Vascular re-intervention and Death)
Skin Perfusion Pressure (SPP) Measurement

Statistical Analysis

Statistical analysis was performed using SPSS software.
A Case of Direct Group
A Case of Direct Group Occlusion

Pre EVT

Proximal Leg

Mid Leg

Foot

Post EVT

PA

ATA PTA

PA

ATA PTA

PA

ATA PTA

PA

ATA PTA

ATA

PTA

ATA

PTA

ATA

PA

99% delay

Occlusion

Occlusion
3 Months After EVT
Pre EVT A Case of Indirect Group

PTA

ATA Occlusion

Failed ATA intervention

PTA 90%
<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Direct Group (n=33)</th>
<th>Indirect Group (n=23)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>73.0±8.0</td>
<td>69.4±10.5</td>
<td>0.153</td>
</tr>
<tr>
<td>Male Gender</td>
<td>28 (84.8%)</td>
<td>19 (82.6%)</td>
<td>0.822</td>
</tr>
<tr>
<td>Hypertension</td>
<td>19 (57.5%)</td>
<td>15 (65.2%)</td>
<td>0.565</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>27 (81.8%)</td>
<td>17 (73.9%)</td>
<td>0.478</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>12 (36.4%)</td>
<td>12 (52.2%)</td>
<td>0.279</td>
</tr>
<tr>
<td>Dialysis</td>
<td>23 (70.4%)</td>
<td>14 (60.7%)</td>
<td>0.336</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
<td>18 (54.5%)</td>
<td>11 (47.8%)</td>
<td>0.621</td>
</tr>
<tr>
<td>Cerebrovascular Disease</td>
<td>7 (21.2%)</td>
<td>4 (17.4%)</td>
<td>0.723</td>
</tr>
</tbody>
</table>
# Laboratory Data

<table>
<thead>
<tr>
<th></th>
<th>Direct Group (n=33)</th>
<th>Indirect Group (n=23)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c</td>
<td>6.2±1.3</td>
<td>6.2±1.3</td>
<td>0.984</td>
</tr>
<tr>
<td>LDL-Cholesterol</td>
<td>77.5±20.5</td>
<td>81.7±21.9</td>
<td>0.479</td>
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<tr>
<td>Triglycerides</td>
<td>94.8±38.1</td>
<td>97.5±40.2</td>
<td>0.799</td>
</tr>
<tr>
<td>HDL-Cholesterol</td>
<td>43.0±13.6</td>
<td>41.7±11.5</td>
<td>0.695</td>
</tr>
<tr>
<td>Left Ventricular Ejection Fraction</td>
<td>65.7±10.7</td>
<td>58.3±14.9</td>
<td>0.105</td>
</tr>
<tr>
<td>C-Reactive Protein Level</td>
<td>2.8±5.5</td>
<td>3.8±5.7</td>
<td>0.504</td>
</tr>
</tbody>
</table>
## Lesion Characteristics and Flow Data

<table>
<thead>
<tr>
<th></th>
<th>Direct Group (n=33)</th>
<th>Indirect Group (n=23)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of Diseased Arteries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before EVT</td>
<td>$2.39 \pm 0.75$</td>
<td>$2.65 \pm 0.57$</td>
<td>$0.169$</td>
</tr>
<tr>
<td><strong>Target Lesions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TASC D Lesions</td>
<td>10 (30.3%)</td>
<td>18 (78.3%)</td>
<td>$0.0001$</td>
</tr>
<tr>
<td>CTO</td>
<td>21 (63.6%)</td>
<td>21 (91.3%)</td>
<td>$0.02$</td>
</tr>
<tr>
<td>Vessel Calcification</td>
<td>21 (63.6%)</td>
<td>17 (73.9%)</td>
<td>$0.418$</td>
</tr>
<tr>
<td><strong>SPP Before EVT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dorsum Foot</td>
<td>$38.3 \pm 19.3$</td>
<td>$26.9 \pm 13.5$</td>
<td>$0.065$</td>
</tr>
<tr>
<td>Plantar Foot</td>
<td>$38.6 \pm 19.9$</td>
<td>$25.3 \pm 17.5$</td>
<td>$0.062$</td>
</tr>
<tr>
<td><strong>SPP After EVT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dorsum Foot</td>
<td>$48.8 \pm 15.7$</td>
<td>$42.8 \pm 25.7$</td>
<td>$0.412$</td>
</tr>
<tr>
<td>Plantar Foot</td>
<td>$43.7 \pm 20.4$</td>
<td>$50.3 \pm 16.9$</td>
<td>$0.379$</td>
</tr>
</tbody>
</table>

CTO: Chronic Total Occlusion; EVT: EndoVascular Therapy; SPP: Skin Perfusion Pressure; TASC: TransAtrantci InterSociety Consensus.
Major Amputations Rate One Year After EVT

Direct Group (n=33)  Indirect Group (n=23)

3.0%  43.4%

p=0.0001
Amputation-Free-Survival Rate
One Year After EVT

- Direct Group
- Indirect Group

91.0% at 1 year
56.5% at 1 year

p=0.002
Major Adverse Limb Events

Direct Group
(n=33)  
24.2%

Indirect Group
(n=23)  
60.9%

p=0.006
Number of Diseased Arteries After EVT

Before EVT: p=0.169
After EVT: p=0.0001

- Direct Group
- Indirect Group
## Predictors For Major Amputation

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect Flow</td>
<td>24.6</td>
<td>2.85-212.2</td>
<td>0.0001</td>
</tr>
<tr>
<td>SPP Before EVT</td>
<td>1.27</td>
<td>1.004-1.598</td>
<td>0.038</td>
</tr>
<tr>
<td>SPP After EVT</td>
<td>1.27</td>
<td>0.968-1.673</td>
<td>0.021</td>
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<tr>
<td>C-Reactive Protein</td>
<td>2.96</td>
<td>0.732-12.0</td>
<td>0.119</td>
</tr>
<tr>
<td>No. of Diseased Arteries After EVT</td>
<td>2.92</td>
<td>0.734-11.585</td>
<td>0.119</td>
</tr>
</tbody>
</table>

*CI*: Confidence interval; *EVT*: Endovascular Therapy; *SPP*: Skin Perfusion Pressure
Conclusion

Acquiring direct flow based on the angiosome concept may be important for preventing limb loss in CLI patients with isolated BTK lesions.