The Angiosome Concept is Not Necessary To Achieve Limb Salvage with Ischemic Gangrenous Foot Lesions

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Disclosure
None

According to the Angiosome Concept

ENDOVASCULAR OPEN Qx by pass

Wound Related Artery Revascularization

Efficacy of dorsal pedal artery bypass in limb salvage for ischemic heel ulcers

Most critics believe that regardless of which angiosome is revascularized, bypasses to any of the three crural arteries should provide adequate inflow to the entire foot because of the presence of collateral vessels

Concept of Foot Revascularization based on surgical experience in Limb salvage
Peroneal Artery Indirect Revascularization to almost all ischemic lesions in the foot

Arterial- Arterial Anastomosis & “Choke Vessels”

Choke Vessels Changing caliber vessels

“Angiome Theory” Anatomical not Physiological Concept

Ischemia-Collaters Formation Revascularization-Reperfusion Dynamic Process

Different distribution of arterial lesions in DM and non-DM

Multiple Angiosomes involved in one foot & one ulcer
Wound Healing in CLI and DM stratified by the Pedal Arch Classification

Kawarada O; Cath Cardiovasc Interv 2012

Personal Artery Endovascular Angioplasty and Indirect Revascularization of ATA-PTA Angiosomes

Believe that the blood supplied by a bypass graft is sufficient to fill the entire foot, regardless of the angiosome.

16% anatomical variations of arteries that fed angiosome.

52 non-healing leg ulcers in 48 patients

8 Distal bypasses

Time to Heal was not significant different (162.4 d vs 159.8 d p= 0.95)

No mention the difference in ischemic wound status

Quality of Pedal arch rather than Angiosome is what influence the Rate of Wound Healing in CLI + DM

Run off Vessels and Angiosome Revascularization

The impact of arterial pedal arch quality and angiosome revascularization on foot times less Sealing and atherosclerotic bypass outcome

Table II. Angiosome size for three zones is indirect revascularization

Quality of Pedal arch rather than Angiosome is what influence the Rate of Wound Healing in CLI + DM
Utility of direct angiosome revascularization and runoff scores in predicting outcomes in patients undergoing revascularization for critical limb ischemia:

- DR according to pedal angiosomes provides more efficient wound healing following tibial/pedal bypass
- Is possible in only one-half the patients
- DR is associated with improved runoff scores

76 ischemic ulcers with single outflow vessels
41 surgical revascularizations
35 endovascular revascularizations

Type of revascularization
- 45 Direct (DR)
- 31 Indirect (IR)

Systematic Review and Meta-analysis of Direct Versus Indirect Angiosomal Revascularization of Infrapopliteal Arteries
D.C. Bosanquet
Eur J Vasc Endovasc Surg 2014; 48: 88-97

Wound Healing
- 11 papers
- DR is associated with significantly greater wound healing rate compared with IR (OR 0.40, p < 0.001)
- Effect maintained in all sensitivity analyses and no heterogeneity

Limb Salvage
- 14 papers
- DR is associated with significantly improved limb salvage rate compared with IR (OR 0.24, p < 0.001)
- Also associated with improved angiosome reconstruction

Clinical Study
Results of Infrainguinal Endovascular Procedures Performed in Diabetic Patients with Critical Limb Ischemia and Tissue Loss from the Perspective of an Angiosome-Oriented Revascularization Strategy
Francisco Asta, César Varela, Ignacio López de Mateos, Ines Gas de Barros, Mirta Blaha, and Javier Rodriguez-Padilla

- 41 surgical revascularizations
- 35 endovascular revascularization
- Type of revascularization
- 45 Direct (DR)
- 18 Indirect with patent arterial-arterial connection to angiosome with a wound
- 31 Indirect (IR)


• Observational studies & retrospective
• 6 High-Quality Papers (NO score >6)
Systematic Review and Meta-analysis of Direct Versus Indirect Angiosomal Revascularization of Infrainguinal Arteries
D.C. Bosanquet
Eur J Vasc Endovasc Surg 2014; 48: 88-97

The importance of the angiosome concept to achieve limb salvage in ischemic lesions in DM

- Retrospective analysis form 2013-2014
- In diabetic patients undergoing endovascular revascularization for ischemic gangrenous foot lesions.

Aim
- Analyze the influence of Angiosome Concept in Limb Salvage of DM patients

Inclusion Criteria
- Ischemic Gangrenous foot lesions
- Tissue loss should not be more of one third of the foot.
- The location area of the lesion and it’s extension must be very well identified and described in detail on file and with photo.
- No ASF or popliteal lesions.
- Follow up at least 12 months

Real life patients in daily practice

Excluded
3 Angiosomes involved

Included
2 Angiosomes involved

The lesion predominantly corresponds to angiosome # 3

Results

From 2013-2014,
45 patients with CLI (Gangrenous Ischemic lesions) were treated for ischemic gangrenous lesions by endovascular method.
22 diabetic patients met the inclusion criteria
Divided in three groups of treatment
I. Direct
II. Indirect
III. Complete (more than one vessel revascularized)
Patients were classified also according to the Angiosome affected or the combination of Angiosomes involved in the lesion.

Number of Angiosomes involved

- 1 Angiosome involved
- 2 Angiosomes involved
- 3 Angiosomes involved

- 22.73%
- 33.82%
- 45.45%
**Distribution of Angiosomes**

- Medial Planter Artery: 13%
- Lateral Planter Artery: 7%
- Dorsalis Pedis Artery: 3%
- Lateral Calcaneal Artery: 2%
- 2 and 4: 2%
- 3 and 4: 2%
- 4 and 5: 2%
- 1 and 3: 2%
- No Angiosomes: 14%

**Demographic Characteristics of Risk Factors according to Revascularization Category**

<table>
<thead>
<tr>
<th>Category</th>
<th>Direct N= 8 (34.8%)</th>
<th>Indirect N= 10 (43.5%)</th>
<th>Complete N= 4 (17.5%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes (DM)</td>
<td>8 (100%)</td>
<td>10 (100%)</td>
<td>4 (100%)</td>
<td>.875</td>
</tr>
<tr>
<td>End Stage Renal Disease (ESRD)</td>
<td>6 (75%)</td>
<td>4 (40%)</td>
<td>2 (50%)</td>
<td>.183</td>
</tr>
<tr>
<td>Coronary Heart Disease (CHD)</td>
<td>5 (62%)</td>
<td>5 (50%)</td>
<td>2 (50%)</td>
<td>.638</td>
</tr>
<tr>
<td>Hypertension</td>
<td>4 (50%)</td>
<td>5 (50%)</td>
<td>2 (50%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>3 (37%)</td>
<td>4 (40%)</td>
<td>2 (50%)</td>
<td>.915</td>
</tr>
<tr>
<td>Smoking (CPD)</td>
<td>3 (37.5%)</td>
<td>4 (40%)</td>
<td>2 (50%)</td>
<td>.915</td>
</tr>
<tr>
<td>COPD</td>
<td>2 (25%)</td>
<td>2 (20%)</td>
<td>1 (25%)</td>
<td>.090</td>
</tr>
</tbody>
</table>

**Number of Angiosomes and Limb Salvage**

<table>
<thead>
<tr>
<th>Type of Plantar Arch and Limb Salvage</th>
<th>Revascularized artery and Limb Salvage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total N</td>
</tr>
<tr>
<td>Artery Treated</td>
<td></td>
</tr>
<tr>
<td>Anterior Tibial Artery</td>
<td>5</td>
</tr>
<tr>
<td>Posterior Tibial Artery</td>
<td>15</td>
</tr>
<tr>
<td>Peroneal Artery</td>
<td>2</td>
</tr>
<tr>
<td>Overall</td>
<td>22</td>
</tr>
</tbody>
</table>

**Category of Revascularization and Limb Salvage**

<table>
<thead>
<tr>
<th>Revascularization</th>
<th>Direct N= 8 (34.8%)</th>
<th>Indirect N= 10 (43.5%)</th>
<th>Complete N= 4 (17.5%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete</td>
<td>8 (100%)</td>
<td>10 (100%)</td>
<td>4 (100%)</td>
<td>.875</td>
</tr>
<tr>
<td>Partial</td>
<td>4 (50%)</td>
<td>4 (50%)</td>
<td>2 (50%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Incomplete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Revascularized artery and Limb Salvage**

<table>
<thead>
<tr>
<th>Case Processing Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTERY TREATED</td>
</tr>
<tr>
<td>Anterior Tibial Artery</td>
</tr>
<tr>
<td>Posterior Tibial Artery</td>
</tr>
<tr>
<td>Peroneal Artery</td>
</tr>
<tr>
<td>Overall</td>
</tr>
</tbody>
</table>
Anterograde and Retrograde Approach

<table>
<thead>
<tr>
<th>APPROACH</th>
<th>Total N</th>
<th>N Dry Salve</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterograde</td>
<td>13</td>
<td>10</td>
<td>76.9%</td>
</tr>
<tr>
<td>Retrograde</td>
<td>1</td>
<td>1</td>
<td>100.0%</td>
</tr>
<tr>
<td>Anterograde - Retrograde</td>
<td>8</td>
<td>4</td>
<td>50.0%</td>
</tr>
<tr>
<td>Overall</td>
<td>22</td>
<td>15</td>
<td>68.2%</td>
</tr>
</tbody>
</table>

Subintimal Tibial Angioplasty

8 weeks 14 weeks
Post Left Subintimal Tibial Angioplasty

Same patient 2 years after 1st angioplasty
MULTIPLE ANGIOSONE INVOLVED
DIFERENTIENDIVASCULAR
TECHNIQUES
Conclusion:

- Collaterals and “Choke vessels” play a major role in the revascularization process and limb salvage of the foot with ischemic gangrenous lesions.
- Only one third of patients with DM have a single angiosome involved in the lesion.
- Limb salvage is a possible option in DM patient ischemic gangrenous lesions and the concept of Angiosome is not mandatory to do the revascularization of this foot.
- Indirect and complete revascularization is always a good option to LS.