ANGIOSOM CONCEPT FOR BTK INTERVENTIONS: HOW TO TRANSLATE IT INTO CLINICAL PRACTISE

Giancarlo Biamino

Disclosure

Speaker name: 
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

ANGIOSOMS

The vascular territories of the region related artery

PROGRESSION OF DIABETES MELLITUS IN THE WORLD

Wild S et Al. Diabetes Care 2004;27:1047-53

60% or more of CLI pts are diabetic

CLI = ischemic diabetic foot

My last 1000 CLI patients
- Rutherford 4-5-6
- 84% DM
- 17% ESRD-HD
- Mean age 72 yy

5% ATG
0 BTK vessel
4%
1 BTK vessel
14%
2 BTK vessels
42%
3 BTK vessels
40%

55% FEM-POP

96% BTK

Courtesy R.Ferraresi
Normal Anatomy: CALF

Anterior Tibial
Peroneal Calcanear Branch
Posterior Tibial

ANGIOSOMES


Literature

R. Ferraresi, L.M. Palena, G. Mauri, M. Manzi
"Below the Ankle Peripheral Artery Disease" in P. Lanzer, E.J. Topol - Panvascular Medicine- 2014 Ed.

"Retrospective angiograms analysis of 1624 patients, treated in our cathlabs between 2009 and 2013, to describe the prevalence of the different patterns of ankle/foot distribution."

Main Distribution Variations at Ankle Level

Plantar Artery from Peroneal

Pedal Artery from Peroneal

2.2%

3.5%

Foot Vessels Distribution

• Balanced Circulation
• Dominant DPA
• Dominant LPA
• Tarsal loop
• Absence of the pedal-plantar loop
• Other abnormalities

[Alson et al. 1997; Manzi et al. 2011; Standring 2008]
**Balanced Circulation**

- 79.15%

**Dominant LPA**

- The dorsalis pedis artery is absent in 13% of cases; in this patient the lateral plantar artery is the predominant artery for the arch.
- 13.2%

**Tarsal Loop**

- The dorsalis pedis artery is absent in 13% of cases; in these patients the lateral tarsal artery is the predominant artery for the 1 toe.
- 7.2%

**Dominant DPA**

- The dorsalis pedis artery supplies the first metatarsal artery; in this patient the medial and lateral plantar arteries are hypoplastic.
- 0.4%

**Absence of the Pedal-Plantar Loop**

- Absence of plantar arch.
- The dorsalis pedis is the predominant artery for the 1 and 2 toes.
- The lateral plantar artery is the predominant artery supplying the 3, 4, and 5 toes.
- 0.2%

**Other Abnormalities**

- Loop on 1st Toe between medial plantar and tarsal via first metatarsal and arch.
- < 0.1%
CONCLUSIONS 1

• The Knowledge of the normal and variant foot vessels anatomy is mandatory for a correct endo treatment

• Pay attention to the calcifications “natural roadmap” to discover or suspect variants

CONCLUSIONS 2

• Pedal Angioplasty is indicated for wound healing improvement above all in surgical ones

• The transpedal PPL & all retrograde techniques can improve success rate in “Desertic Feet”

UNDERSTANDING ANGIOSOMES

The acute occlusion of one of the Tibial or Foot arteries could be immediately be compensated by the ANASTOMOTIC System

Angiome-based revascularization concept

PTA following the Angiosome Concept

PTA following the Angiosome Concept

That’s why The Concept Can Work!
### Characteristics of observational studies evaluating the outcome after direct versus indirect revascularization for ischemic tissue lesions of the foot.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of publication</th>
<th>Type of study</th>
<th>Treatment method</th>
<th>Disease stage</th>
<th>No. limbs</th>
<th>Follow-up (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varela</td>
<td>2010</td>
<td>retrospective</td>
<td>Endo/Surg</td>
<td>ABI&lt;0.50/TP &lt; 50, wound</td>
<td>45</td>
<td>31</td>
</tr>
<tr>
<td>Alexandrescu</td>
<td>2011</td>
<td>retrospective</td>
<td>Endo</td>
<td>Diabetic ischemic wound</td>
<td>134</td>
<td>58</td>
</tr>
<tr>
<td>Myatt et al.</td>
<td>2011</td>
<td>retrospective</td>
<td>Endo</td>
<td>Rutherford 5-6</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Azuma et al.</td>
<td>2012</td>
<td>retrospective</td>
<td>Surg</td>
<td>Rutherford 5-6</td>
<td>125</td>
<td>92</td>
</tr>
<tr>
<td>Iida et al.</td>
<td>2012</td>
<td>retrospective</td>
<td>Endo</td>
<td>Diabetes ischemic wound</td>
<td>173</td>
<td>153</td>
</tr>
<tr>
<td>Ferrufino-Mérida</td>
<td>2012</td>
<td>prospective</td>
<td>Endo</td>
<td>Diabetes ischemic wound</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>Blanes Orti</td>
<td>2011</td>
<td>retrospective</td>
<td>Endo</td>
<td>Rutherford 5-6</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Söderström</td>
<td>2013</td>
<td>retrospective</td>
<td>Endo</td>
<td>Diabetic ischemic wound</td>
<td>121</td>
<td>129</td>
</tr>
<tr>
<td>Kabra et al.</td>
<td>2013</td>
<td>prospective</td>
<td>Endo/Surg</td>
<td>Rutherford 5-6</td>
<td>39</td>
<td>25</td>
</tr>
<tr>
<td>Lejay et al.</td>
<td>2013</td>
<td>retrospective</td>
<td>Surg</td>
<td>Diabetic ischemic wound</td>
<td>36</td>
<td>22</td>
</tr>
</tbody>
</table>

**WHAT THIS PAPER ADDS**

The results of this meta-analysis suggest that, when feasible, direct revascularization of the foot angiosome affected may improve wound healing and limb salvage rates compared with indirect revascularization.

**Issue of clinical setting (practice) in Angiome concept**

- In the clinical setting, revascularization for ischemic wounds through their specific source artery is not always successful because of technical barriers and lesion severity.
- Approximately 40-50% of patients were reluctantly treated with indirect revascularization (IR).

**Discrepancy from theory to practice in Angiome concept**

- Consequently, moderate limb salvage rates (68-76%) were obtained by indirect revascularization (IR) in earlier studies.
- However, it remains unclear which patients derive the most clinical benefit from direct revascularization (DR).

**Angiosome relevance for treatment**

- Long-term results of direct and indirect endovascular revascularization based on the angiome concept in patients with critical limb ischemia presenting with isolated below-the-knee lesions.

**Angiome-based Lower Limb Revascularization for Ischemic Foot Wounds: Systematic Review and Meta-analysis**

**WHAT THIS PAPER ADDS**

The results of this meta-analysis suggest that, when feasible, direct revascularization of the foot angiosome affected may improve wound healing and limb salvage rates compared with indirect revascularization.

**Issue of clinical setting (practice) in Angiome concept**

- In the clinical setting, revascularization for ischemic wounds through their specific source artery is not always successful because of technical barriers and lesion severity.
- Approximately 40-50% of patients were reluctantly treated with indirect revascularization (IR).
What are the optimal outcomes for patients with CLI receiving revascularization?

The primary goals of the treatment of CLI are to
- relieve ischemic pain
- heal (neuro) ischemic ulcers
- prevent limb loss
- improve patient function and quality of life
- prolong survival

⇒ A primary outcome would be amputation-free survival (AFS) + wound healing

* To achieve these outcomes, most patients will ultimately need a revascularization procedure requiring referral to a vascular specialist.

Indirect EVT for CLI with CRP ≥ 3 mg/dl increased risk for mMALE only in diabetic patients

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Non-diabetes with CRP ≥ 3 mg/dl</th>
<th>Diabetes mellitus</th>
<th>Hazard ratio for mMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>- -</td>
<td>463</td>
<td>159</td>
<td>1.00 (Ref)</td>
</tr>
<tr>
<td>● -</td>
<td>443</td>
<td>21</td>
<td>0.88 [0.67, 1.15]</td>
</tr>
<tr>
<td>- ●</td>
<td>21</td>
<td>1.05 [0.54, 2.04]</td>
<td></td>
</tr>
<tr>
<td>● ●</td>
<td>95</td>
<td>2.17 [1.54, 3.06]</td>
<td></td>
</tr>
</tbody>
</table>

Comparison of rate of complete AFS and freedom from MALE between direct and indirect angiosome-oriented revascularization

There was no significant difference in terms of AFS and freedom from MALE

Comparison of rate of complete wound healing between direct and indirect angiosome-oriented revascularization

✓ After propensity matching of patient characteristics, analysis showed better wound healing in the DR than IR group.
✓ The median time to wound healing in the DR group was associated with faster wound healing; hazard ratio of DR relative to IR for wound healing 1.4 (95% CI 1.2-1.6).

Discrepancy between limb salvage (LS) and wound healing (WH) rate

Approximately 20% CLI patients are free from death and amputation without complete wound healing.

Predictors of Complete Wound Healing after EVT in Patients with CLI due to Isolated BTK Lesions

73% 52%

Rutherford 5
Rutherford 6
Angioplasty of Foot Arteries

Diabetic Rutherford 5

Antegrade recanalisation failed

Angioplasty of the Foot-Loop

Which artery should be chosen?

So far only retrospective studies available

Which artery to revascularize is a case to case decision

PTA following the Angiosome-Concept or as many Arteries as Possible?

- Retrospective analysis of 1268 CLI-patients
- and PTA BTK
- Mean number of treated arteries / patient 1.77
- Most important factor influencing limb salvage was the number of patent arteries post PTA.

Authors-conclusion: every effort should be made to open up as many arteries as possible BTK.

Peregrin et al., Cardiovasc Intervent Radiol 2010;33:720-725
PTA of all 3 BTK-Arteries

Option in case of crossing failure:
Combined antegrade-retrograde approach

The Double-Balloon Technique

Conclusions

- The recent meta-analysis suggest that direct revascularization of the foot angiome affected may improve wound healing and limb salvage rates compared with indirect revascularization.
- Low albumin level, Rutherford 6 (not only heel), wound infection, indirect intervention, and poor BTA run-off were independent predictors for clinical failure: death, amputation, delayed wound healing after EVT in patients with CLI secondary to infrapopliteal lesions.

⇒ Better quality of endovascular intervention including direct EVT and more below the ankle run-off appears to be the only way to improve clinical outcomes.

Summary

The strategy for BTK revascularization should be made patient specific considering the location and the severity of tissue loss, the angiographic findings and the co-morbidities (diabetes).

Whenever possible (particularly in case of severe tissue loss) a „maximal“ revascularization should be attempted (either interventionally or surgically).
Interventional approach in DM-CLI

Work in a multidisciplinary team: the time of lonely physicians is finished!

Courtesy of R. ferraresi

Diabetic foot centers

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic Center</td>
<td>Diabetic Foot Center</td>
<td>Specialized Diabetic Foot Clinic</td>
</tr>
<tr>
<td>Education</td>
<td>Education</td>
<td>Education</td>
</tr>
<tr>
<td>Primary Prevention</td>
<td>Primary Prevention</td>
<td>Primary Prevention</td>
</tr>
<tr>
<td>Treatment of ulcers</td>
<td>Drainage of venous ulcer</td>
<td>Treatment of ulcers</td>
</tr>
<tr>
<td>Minor amputation</td>
<td>Surgical amputation</td>
<td>Arterial Surgery</td>
</tr>
<tr>
<td>Dressing</td>
<td>Off-loading</td>
<td>Surgery diabetic foot deformity (Charcot)</td>
</tr>
</tbody>
</table>

The End

Diabetic CLI Treatment: The Italian Model

International Working Group on the Diabetic Foot

Diabetes Care, in press

VEITH Symposium
Connecting the Vascular Community