When does the angiosome concept make a difference and when not?

Richard F. Neville, MD
Associate Director, INOVA Heart and Vascular Institute
Vice-Chairman, Department of Surgery
Director of Vascular Services
Falls Church, Virginia

Disclosures
• Nothing to disclose

Angiosomes of the lower leg and foot

Six distinct angiosomes:
• Anterior tibial artery (1)
• Dorsal pedis
• Peroneal artery (2)
  • Lateral calcaneal
  • Anterior perforator
• Posterior tibial artery (3)
  • Calcaneal
  • Medical plantar
  • Lateral plantar


Angiosome anatomy
Anterior Tibial Artery

Dorsalis pedis
Anterior compartment
Dorsum of foot

Angiosome anatomy
Peroneal Artery

Lateral calcaneal artery
Anterior perforator
Lateral ankle
Lateral plantar heel

Angiosome anatomy
Posterior Tibial Artery

Medial plantar artery
Lateral plantar artery
Calcaneal perforator
Lateral ankle/forefoot
Angiosome anatomy

The issue of indirect connections

Indirect connections

“Choke vessels”

Intact pedal arch

Angiosome revascularization

Direct vs Indirect revascularization

Clinical implications

- 60 consecutive ischemic wounds
- Tibial bypasses
- Direct Revascularization (DR)
  - Bypass to the artery perfusing the wound’s angiosome
- Indirect Revascularization (IR)
  - Bypass to an artery not directly perfusing the angiosome in which the wound was located


Angiosome revascularization

Wound Care

Standard wound care protocol
No difference in wound care between groups

<table>
<thead>
<tr>
<th></th>
<th>DR</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary closure / STSG</td>
<td>55%</td>
<td>24%</td>
</tr>
<tr>
<td>Local amputation Ray/TMA/Chopart</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Free flap</td>
<td>5%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Angiosome revascularization

Degree of complete healing

More complete healing with direct revascularization of the angiosome

<table>
<thead>
<tr>
<th></th>
<th>Complete healing</th>
<th>Failed to heal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR</td>
<td>91%</td>
<td>62%</td>
</tr>
<tr>
<td>IR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P = .001


Angiosome concept; bypass

Oregon Health Sciences University

- Surgical bypass (n=106)
- Only 30% of wounds in a single angiosome
- More complete healing in the DR group (p=.001)
  - DR 78%
  - IR 40%
- More rapid time to healing in the DR group (p=.002)
  - DR 99 days
  - IR 193 days

“DR is a significant predictor for wound healing and reduced healing time”

Angiosome concept; bypass

- Tibial bypass for tissue loss (n=58)
- More rapid healing in the DR group
  - 1 year: 91% vs. 60%
  - 5 years: 81% vs. 18%

"Achieving direct arterial flow based on the angiosome concept appears to be important for ulcer healing and limb salvage."


Angiosome concept; endovascular

- Endovascular revascularization
- Healing of diabetic ischemic ulcers
- More complete healing after DR
  - DR: 83% healed
  - IR: 59% healed

"An angiosome model of perfusion, helps the treatment of diabetic foot ulcers."


Angiosome concept; endovascular

- 203 ischemic ulcers
- Procedures
  - Iliac PTA 17%
  - SFA stenting 54%
  - Tibial PTA 82%
- Healing improved with DR
  - DR: 86%
  - IR: 69%

"The angiosome model is important for ulcer healing in diabetic patients."


Angiosome concept; bypass

Universities of Poitiers and Bologna

- Peroneal bypass (n=120)
- 46% in a peroneal angiosome
- Amputation free survival (3 years)
  - DR and IR made no difference
- Improved amputation free survival (3 years)
  - Patency of both peroneal branches
  - Patency of pedal arch


The angiosome concept

Should be considered......

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Indirect</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neville</td>
<td>91</td>
<td>62</td>
<td>Bypass</td>
</tr>
<tr>
<td>Lćjay</td>
<td>91</td>
<td>66</td>
<td>Bypass</td>
</tr>
<tr>
<td>Alexandrescu</td>
<td>83</td>
<td>59</td>
<td>Endovascular</td>
</tr>
<tr>
<td>Iida</td>
<td>86</td>
<td>69</td>
<td>Endovascular</td>
</tr>
<tr>
<td>Kret</td>
<td>78</td>
<td>46</td>
<td>Bypass</td>
</tr>
<tr>
<td>Kabra</td>
<td>96</td>
<td>83</td>
<td>Bypass/Endo</td>
</tr>
<tr>
<td>Soderstrom</td>
<td>72</td>
<td>45</td>
<td>Endovascular</td>
</tr>
</tbody>
</table>

Over 700 limbs studied.
Discordant results……
Do we need a new category?

- When does the concept not make a difference?
  - Wounds not located in a single, distinct angiosome
  - Specific angiosome related revascularization not possible

- Indirect with connections (IRc)
  - Direct (DR) vs Indirect with connections (IRc)
    - No difference in healing and limb preservation
  - Indirect (IR) vs Indirect with connections (IRc)
    - IR with significant difference in healing and limb preservation


Conclusion

- Revascularization (DR/IRc) of the appropriate angiosome does result in increased healing
- The angiosome concept should be considered in planning revascularization for healing
- The angiosome concept makes a difference when it can be utilized without sacrifice of other key principles of revascularization

Thank you