Angiosomes Have Little Value in Diabetic Limb Salvage: WfI Staging is a Better Predictor

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Disclosures
• None

Angiosomes
• Angiosomes
  • Concept defined by Ian Taylor in 1987
  • Divides body into 3D anatomic units supplied by specific arteries
  • Five units of the foot

Direct Angiosome Revascularization
• Specific source vessel supplying the wound is revascularized
• Improve wound healing and limb salvage

Definitions
• Direct Revascularization
  • Open line from aorta to the artery supplying the wound angiosome (Lida)
  • Heel and forefoot are PT (Alexandrescu)
  • The angiosome artery revascularized matches that of the foot loss (Attinger)
  • Little consensus when wounds span more than one angiosome or requires minor amputation

Feasibility
The Feasibility of Angiosome-Targeted Endovascular Treatment in Patients with Critical Limb Ischemia and Foot Ulcer

• 160 Patients
• 161 BTK PTA
• PTA feasible if ≥50% stenosis of a tibial vessel with patent outflow
Feasibility

The Feasibility of Angiosome-Targeted Endovascular Treatment in Patients with Critical Limb Ischemia and Foot Ulcer

- 3 Groups
  - 1 vessel feasible (A)
  - 2 vessels feasible (B)
  - 3 vessels feasible (C)
- Then looked at DR success

Feasibility & Anatomy

- 160 patients, 161 BTK PTA
- In CLTI, 76% wounds typically involved >1 angiosome
- 1/3 of patients only have one tibial vessel suitable for PTA
- DR possible in the majority of patients

Collateral Controversy

- 486 limbs, 3 angiosome groups
  - Direct (DR), n=152
  - Indirect with collaterals (IR-wc), n=209
  - Indirect without collaterals (IR-w/o c), n=125

Effect of Collaterals

- Collaterals must connect the wound angiosome
Effect of Collaterals

The Use of the Angiome Concept for Treating Infra-arterial Critical Limb Ischemia through Interventional Therapy and Determining the Clinical Significance of Collateral Vessels

1 year outcomes
• 52% healing rate,
• 83% limb salvage

<table>
<thead>
<tr>
<th></th>
<th>1 year DR</th>
<th>IR-wc</th>
<th>P</th>
<th>R-w/o c</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Healed Ulcer</td>
<td>68%</td>
<td>65%</td>
<td>.036</td>
<td>16%</td>
<td>&lt;.001</td>
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<tr>
<td>Limb Salvaige</td>
<td>89%</td>
<td>85%</td>
<td>.28</td>
<td>70%</td>
<td>&lt;.001</td>
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</table>

What about the wound?

Open vs. Endo

Angiome Targeted PTA is More Important in Endovascular Revascularisation than in Surgical Revascularisation: Analysis of 545 Patients with Ischaemic Tissue Lesions

545 diabetic patients with CLTI
• Infrapopliteal endo or open
• Compared DR vs. IR

Conclusions
• 60% of wounds healed by 1 year
• Direct bypass best (77%)
• Indirect PTA worst (52%)
• 25% major amp at 1 year
• Direct PTA associated with a lower rate of major amp than indirect PTA (HR 0.57)
• DR more important in endo than open

The SVS-WIfI Threatened Limb Classification

• Wound, Ischemia, foot Infection
• 4 grades each (0-3)
• Interplay predicts 1 year limb salvage

Open vs. Endo

What about the wound?

The WIfI Classification Validation

An early validation of the Society for Vascular Surgery Lower Extremity Threatened Limb Classification System

Table IV. Observed 1-year outcomes by Wound characteristics, ischaemia, and foot infection (WIFI clinical stage)

(J Vase Surg 2010;51:1535-42.)
The WIfI Classification

More than just limb salvage

Study Design

- Compare predictive ability of WIfI classification vs direct angiosome perfusion for wound healing
- Pedal arch grade (marker of pedal small vessel disease)
  - 0: Widely patent with retrograde flow
  - 1: Widely patent without retrograde flow
  - 2: Diseased or partially occluded pedal arch
  - 3: Little or no pedal arch
- Primary Outcome: Wound healing at 1 year

Primary Outcome

- Wound Healing at one year
- Management
  - Angiography with intent to perform revascularization, preferentially direct
  - Perfusion optimized if no direct options
    - Indirect ± Collateral/Arch PTA
    - Debridement, local wound care, minor amputation via Multidisciplinary Team

Angiosome Directed Perfusion

Wounds characteristics determine wound healing

Table 1. Each of variables associated with diabetic foot ulcer (DFU) healing is shown with corresponding coefficients and respective p-values

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Study Cohort

- 225 Wounds
  - Mean age 63 years
  - 62.6% male
  - Hypertension 87.9%
  - Dyslipidemia 65.7%
  - Tobacco Use 54.5%
  - Hgb A1c 8.4%
  - Insulin 56.6%

Wound Characteristics

- Characteristic
  - Overall N = 225
  - Mean age (years) 87.9
  - Mean depth (cm) 3.5
  - Tissue deep to periosteum (cm) 2.5
  - Revascularization approach
    - Endovascular
    - Open
    - Difficult to access (per month) 0.07 (0.05-0.09)

Univariable Analysis

- Univariable Results
  - P < .001
  - P = .89

Multivariable Analysis

- Model
  - Healed vs. Not Healed
  - OR (95% CI) P-value
  - Revascularization approach
    - Endovascular
    - Open
    - Difficult to access
    - P < .001

Results: Subanalysis

- Table
  - Healed vs. Not Healed
  - P-value
  - Stage 1-2
  - Stage 3-4
  - Anatomic arch grade
    - Overall
    - P < .05
Conclusion

- While direct angiosome perfusion was not related to wound healing, it may be important in higher WIfI stages
- WIfI classification has broad applicability
- WIfI stage and wound characteristics should be standard inclusion in all future angiosome studies

Conclusion

- Definition consensus needs to be achieved in order to compare angiosome outcomes
  - Direct revasc in presence of wounds vs. minor amputations
  - Collaterals

Results

- 65 yo male with 3mo h/o plantar ulcer
- A1C 11%
- Probes to bone
- ABI NC, TP 38
- Tunneling wound: 3x3x1.5cm

Results

<table>
<thead>
<tr>
<th>Pre</th>
<th>Peroneal PTA</th>
<th>Collaterals</th>
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<tr>
<td><img src="image1.png" alt="Image" /></td>
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