In foot treatment: what not to do? clinical experience

E. Ducasse MD PhD FEVBS
Unit of vascular surgery
CHU bordeaux
Disclosure

Speaker name:

Pr E Ducasse

- I do not have any potential conflict of interest
Actual BTK treatment strategy

- BTK occlusions in CLI\(^1,2\):
  - $\geq 50\%$ of CLI patient
  - $\geq 70\%$ of CLI patients with DM - ESRD
- BTA\(^3\)
  - 55\% of CLI patient have 2-3 BTA vessel disease
  - $\approx 25\%$ with arch disease (50\% with DM - ESRD)

$\rightarrow$ ENDOVASCULAR FIRST\(^4\)
- Ischemic angiosome\(^5,6\) = first target artery
  - If not possible
    $\rightarrow$ restore as much blood flow as possible to the foot

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<table>
<thead>
<tr>
<th>Grade</th>
<th>Ulcer</th>
<th>Gangrene</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No ulcer</td>
<td>No gangrene</td>
</tr>
</tbody>
</table>

Clinical description: ischemic rest pain (requires typical symptoms + ischemia grade 3); no wound

1  | Small, shallow ulcer(s) on distal leg or foot; no exposed bone, unless limited to distal phalanx | No gangrene |

Clinical description: minor tissue loss. Salvageable with simple digital amputation (1 or 2 digits) or skin coverage

2  | Deeper ulcer with exposed bone, joint or tendon; generally not involving the heel; shallow heel ulcer, without calcaneal involvement | Gangrenous changes limited to digits |

Clinical description: Major tissue loss salvageable with multiple (≥3) digital amputations or standard transmetatarsal amputation (TMA) ± skin coverage

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**Table 1 - Society for Vascular Surgery Lower Extremity Threatened Limb Classification System.**

<table>
<thead>
<tr>
<th>Grade</th>
<th>ABI</th>
<th>Ankle systolic pressure, mm Hg</th>
<th>TP, TcPO2, mm Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>≥ 0.80</td>
<td>&gt;100</td>
<td>≥ 60</td>
</tr>
<tr>
<td>1</td>
<td>0.6–0.79</td>
<td>70–100</td>
<td>40–59</td>
</tr>
<tr>
<td>2</td>
<td>0.4–0.59</td>
<td>50–70</td>
<td>30–39</td>
</tr>
<tr>
<td>3</td>
<td>≤ 0.39</td>
<td>≤ 50</td>
<td>≤ 30</td>
</tr>
</tbody>
</table>

Clinical description: Extensive, deep ulcer involving forefoot and/or midfoot; deep, full thickness heel ulcer ± calcaneal involvement

Clinical description: Extensive gangrene involving forefoot and/or midfoot; full thickness heel necrosis ± calcaneal involvement

Clinical description: Extensive tissue loss salvageable only with a complex foot reconstruction or nontraditional TMA (Chopart or Lisfranc); flap coverage or complex wound management needed for large soft tissue defect

**I: ISCHEMIA**

Hemodynamics/perfusion: measure TP or TcPO2 if ABI incompressible (>1.3)

SVS grades 0 (none) 1 (mild) 2 (moderate) 3 (severe)

Clinical manifestation of infection

No symptoms or signs of infection

Infection present, as defined by the presence of at least 2 of the following items:

- Local swelling or induration
- Erythema >0.5 to ≤2 cm around the ulcer
- Local tenderness or pain
- Local warmth
- Purulent discharge (thick, opaque to white, or sanguineous secretion)

Local infection involving only the skin and the subcutaneous tissue (without involvement of deeper tissues and without systemic signs as described below).

Exclude other causes of an inflammatory response of the skin (e.g., trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis).
5. Peripheral arterial disease (PAD) and the DFU

Recommendation 1.1: We suggest that patients with diabetes have ankle-brachial index (ABI) measurements performed when they reach 50 years of age (Grade 2C).

Recommendation 1.2: We suggest that patients with diabetes who have a prior history of vascular examination, prior intervention for peripheral vascular disease (eg, coronary, cerebral, or renal) have an annual vascular examination, including ABI and toe pressures (Grade 2C).

Recommendation 2: We recommend that pedal Doppler arterial pressures be obtained annually (Grade 2C).

Revascularization can be based on the Society for Vascular Surgery Infection (SVSI) lower extremity threatened limb classification. However, infection extent is required to select patients appropriately for revascularization.

- In functional patients with long-segment occlusive disease and a good autologous conduit, bypass is likely to be preferable.
- In the setting of tissue loss and diabetes, prosthetic bypass is inferior to bypass with vein conduit.

The choice of intervention depends on the degree of ischemia, the extent of arterial disease, the extent of the wound, the presence or absence of infection, and the available expertise.

Choose wisely your approach

1/ Antegrade approach

- Controlateral approach with crossover
  - If associated proximal lesion (iliac/SFA)
  - Obese patients

- Ipsilateral antegrade approach +++
  - Support, pushability and trackability
  - CFA or proximal SFA (same morbidity)

  - Short 6F sheath
    - Then optimal placement of long (55-110cm) 4F sheath inside for BTK segment

  - Or short then long 4 or 5F sheath alone

CHOOSE WISELY YOUR APPROACH

LESSON N°1: BE PRECISE

1/ Antegrad approach

1/ Endoluminal +++

PROS
- Standard technique
- More experience
- Seems more physiological
- No re-entry problem

CONS
- Not always possible in long calcified lesions
- Possible unsatisfactory results after balloon PTA

2/ Subintimal

PROS
- Smoother lumen
- Less distal embolization?

CONS
- Long learning curve
- Re-entry difficult to control
- Risk of collateral occlusion
- Risk of vessel perforation

CHOOSE WISELY YOUR APPROACH

LESSON N°1: BE PRECISE
2/ Retrograde approach if unsuccessful (≈20%)

**Indications**
1) Inability to correctly identify the origin of peroneal of tibial artery
2) Rupture or loss of the antegrade vessel pathway
3) Inability to re-enter into the true lumen
4) High risk to damage distal target vessel by continuing antegrade approach while it might be the only landing zone for bypass

**Dedicated material**
- 16-G x 83 mm needle / 21-G micropuncture kit
- Antispasmodic intra-arterial cocktail
- Wires
  - 0.018” = more column strength and pushability
  - 0.014” = less traumatic and lower profile
- Wire excalation strategy
- Support catheters or OTW balloon catheters
  - Improves pushability, Facilitates reshaping/exchange

CHOOSE WISELY YOUR APPROACH

LESSON N°2: BE PRECISE AND GENTLY
**Tibiopedal access**

1) Sheathless approach +++
   - «SAFARI» and procedure resumed by antegrade approach

2) 4 F popliteal sheath / 3F pedal sheath
   - «CART» / «Rendez-vous» technique only

- Hemostasis
  - balloon inflation from antegrade access + manual compression
  - Patency checked by angiography

**PROS**
- Small diameter vessels: increased pushability
- Less likelihood of entering sidebranches
- Distal cap often softer → Easier re-entry
- Limits the extension of dissection → Shorter arterial segment to treat

**CONS**
- Challenging
- Small diameter vessels prone to spasm and dissection
- Often calcified
- Sharp angulation near the ankle
- Long procedure time

LESSON N°2: BE PRECISE AND GENTLY
Optimal patient installation is key

Sterile preparation of both groins + entire leg

1/ ULTRASOUND-GUIDED PUNCTURE

- Identify the target artery in longitudinal view
- Puncture at 45° in transversal view
- Verify intraluminal positionning of guidewire in longitudinal view

LESSON N°2: BE Precise AND GENTLY
2/ FluOroscopy-Guided puncture

- Simple scopy if calcified / proximal injection + road-mapping
- Parallax adjustment +++
  - Needle and artery must be perfectly aligned
  - For ATA, PTA and PA
    - feet attached together in internal rotation
  - For complex vascular anatomy of the foot and plantar arch
    - Foot in abduction + Standard anteroposterior and lateral oblique projections

OPTIMAL PATIENT INSTALLATION IS KEY

LESSON N°2: BE PRECISE AND GENTLY
1) Pedal-plantar loop technique for reconstruction of plantar arch
   - Low-profile balloons
     - Dedicated diameter 1.5 to 4 mm
     - Dedicated length: Avoid long balloons
       - High early restenosis rates (< 2 years)

Werner M et al. Liepzig group - LINC

8. From Manzi et al.
1) Pedal-plantar loop technique for reconstruction of plantar arch

- Dedicated diameter 1.5 to 4 mm
- Dedicated length: Avoid long balloons
  - High early restenosis rates (< 2 years)
  - Not compliant enough → arterial stress → hyperplasia
- Prefer repeated inflations with short balloons
  - Only treat occluded or heavily diseased foot vessels
  - Respect the distribution system if it seems satisfactory
Technical success: 93%

- wound healing
  - With below the ankle angioplasty = 93%
  - Without below the ankle angioplasty = 60%

Wound healing time: 86.0 ± 18.7 with BTA angioplasty vs 152.0 ± 60.2 days


LESSON N°3: LOOP-TECHNIQUE: DANGER, BE GENTLY!!

- BTA Angioplasty: very high restenosis rates
- Balloon expandable stents = risk of compression/fracture
  - Foot dorsiflexion with dorsalis pedis
  - Foot plantar flexion with distal post tibial
  - Even higher restenosis rates

→ « Treat foot vessels only if you have strong clinical and vascular indications »

Restenosis: 64.1±8.3%
Freedom from reintervention: 93.6±4.3%
CHOOSE WISELY YOUR APPROACH

3/ Transcollateral approach

CLI BTK case

LESSON N°4: IN FOOT WAY FOR RETROGRADE RECANALISATION
3/ Transcollateral approach

LESSON N°4: IN FOOT WAY FOR RETROGRADE RECANALISATION

SPECIFIC 0,014” wire from 20 to 3 gf
SPECIFIC support catheter very soft
3/ Transcollateral approach

LESSON N°4: IN FOOT WAY FOR RETROGRADE RECANALISATION
3/ Transcollateral approach

LESSON N°4: IN FOOT WAY FOR RETROGRADE RECANALISATION
Deep Venous Arterialization

- Venous arterialization = not a new concept\textsuperscript{1-4}
  - Surgical attempts: good safety and clinical outcomes
  - Problems:
    - valves limit blood flow
    - numerous draining venous collaterals “steal” blood flow to extremity

- Percutaneous deep venous arterialization (PDVA)
  - \textit{Pilot study}\textsuperscript{5}
    - 7 “end stage” CLI patients with no remaining open or endovascular options
    - LimFlow: 7F arterial catheter + 5F venous catheter + console to facilitate crossing with needle
    - 0.014” driven across crossover point into retrograde sheath
    - 3 x 40mm balloon to predilate arteriovenous fistula
    - 0.014” exchanged for 0.018” over support catheter
    - reversed valvulotome to disrupt the valves
    - covered stent from posterior tibial vein up to patent posterior tibial artery to cover venous collaterals

5. Changi General Hospital in Singapore.

\textit{Pictures from S.KUM; Y.KAI TAN; T.TANG; A.SCHMIDT; D.SCHEINERT; R.FERRARESI, ENDOVASCULAR TODAY MAY 2015}
Percutaneous Deep Venous Arterialization (PDVA)

- iFlow postprocessing program (Siemens)
  - postprocedure: rapid arrival of contrast (yellow/red)
- No 30-day MAEs
- 6-month results
  - Skin temperature
    - improved on FLIR thermography
  - Complete wound healing in 4
  - Immediate Rest pain in 1
  - Increased transcutaneous oximetry levels in 4
  - Major amputation in 1
- CE Mark study underway
- Pre-investigational device exemption application accepted by FDA

 LESSON N°5: TRY ALL POSSIBILITIES
Take home message

- **Endo first**
- **Angiosome concept**
  - but « 3 remains better than 2 »
- **Antegrade approach first**
  - but always be prepared for retrograde (sheathless +++) / Transcollateral
- **Treat BTA lesions only when clearly necessary**
  - Respect what is still functionning
- **Limit stenting to mandatory situations / avoid at all costs Bellow the ankle**
- **Sharp debridement**
  - but not too extensive at first
  - Pressure offloading
- **Percutaneous deep venous arterialization (PDVA)**
  - could it become a last resort option in desert ft ?
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