Hemodialysis Access Induced Distal Ischemia (HAIDI)


NEFROLOGIA INTERVENTISTICA
Seminario: complicanze accessi vascolari
Roma 10 MAGGIO 2014
Disclosure

☐ P Bourquelot

I have the following potential conflicts of interest to report:

Shire Inc. (consulting)
Without angioaccess, Distal ischemia in the upper limb, is **most unusual**
Clinically significant hand ischaemia occurs in 1.6–8% of all proximal upper extremity accesses.

Predisposing risk factors include female sex, age >60 years, diabetes, multiple previous access procedures on the same arm and the use of the brachial artery as the donor vessel.
Hemodialysis Access Induced Distal Ischemia (HAIDI)

- Is the consequence of the association of:
  1. **Steal**: from the high-pressure artery blood flow by the low-pressure fistula vein
  2. **and Artery Pathology**: atheroma, diabetes, previous angioaccesses sequellae

- resulting in diminution of distal blood flow and critically reduced arterial pressure in the hand.
Ischemic monomelic neuropathy

- Age, diabetes, women, brachial AVF
- Acute postoperative onset
- 3-forearm nerves distal symptoms:
  - pain ++
  - motor dysfunction
- Distal pulse +/-
- Vasa nervorum ischemia at the elbow?
- Urgent AVF ligation... full recovery 4/10
Clinical evaluation (Grades)

1. Cyanosis, mild coldness
2. Pain during dialysis sessions or at hand function
3. Rest pain or motor dysfunction
4. a- Limited ulceration or necrosis
   b- Irreversible tissue loss in the hand
Technical evaluation

☐ Finger pressures measurements and waveform evaluations

☐ Duplex examination and flow measurement

☐ Angiography
Finger pressure measurements and waveform evaluations

Courtesy J. Malik
Pressure cuff
Photoplethysmographic sensor

Courtesy J. Malik
Normal digit waveforms
Lower digit pressures and waveforms on the dialysis access side
Waveform normalisation after AVF compression
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
- 4- Distal revascularization
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
  - Banding
  - RUDI
- 4- Distal revascularization
  - Distal radial artery ligation
  - DRIL & Proximalisation
AVF Ligation
after 1\textsuperscript{st} stage basilic vein superficialization
Grade 4b
Diabetes +
Calcifications
→ AVF
Ligation
1st stage Basilic Plug occlusion
Plug AVF occlusion
Plug AVF occlusion

Amplatzer plug
10mm
Gracz AVF

Proximal cephalic vein

Distal v.

Proximal Basilic V.

Brachial v.
After side branches ligation

Proximal cephalic vein

Brachial artery
Gracz AVF

Brachial artery

Basilic & brachial veins

Cephalic vein

Vaes*, M.R. Scheltinga EJVES 2012
Gracz AVF

Cephalic vein

Vaes*, M.R. Scheltinga EJVES 2012
Diabetes + arterial calcifications → Supernumerary non-matured Fistula Ligation
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
  - Banding
  - RUDI
- 4- Distal revascularization
  - Distal radial artery ligation
  - DRIL & Proximalisation
Subclavian artery stenosis (brachial-basilic AVF) 1/3
Subclavian artery stenosis (brachial-basilic AVF) 2/3
Subclavian artery stenosis (brachial-basilic AVF) 3/3
Transposition of the subclavian artery to common carotid artery

Courtesy V. Mickley
Ulnar artery stenosis (radial-cephalic AVF) 1/2
Ulnar artery PTA (radial-cephalic AVF) 2/2

Before PTA

After PTA
Axillary irradiation
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
  - Banding
  - RUDI
- 4- Distal revascularization
  - Distal radial artery ligation
  - DRIL & Proximalisation
Banding (Pros and Cons)

- High caliber reduction (>80%) is necessary
- 2 major postoperative risks:
  - Persistent high-flow and steal
  - Access thrombosis
- Odland 1991:
  - 16 patients
  - 6 months primary patency: 63%
## Banding (Pros and Cons)

<table>
<thead>
<tr>
<th>Nº Pts reviewed</th>
<th>Banding technique</th>
<th>Clinical Success</th>
<th>Patency</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>Blind</td>
<td>60%</td>
<td>53%</td>
</tr>
<tr>
<td>70</td>
<td>Perop flow &amp; pressure measurements</td>
<td>89%</td>
<td>97%</td>
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</tbody>
</table>

Scheltinga JVA 2009
Banding
Banding

1800 mL/min
Banding Miller-variant 2010
(minimally invasive technique)
Miller 2010

- Retrospective multicentric study:
  - 113 pts
  - Local anesthesia
  - Intra-luminal balloon for sizing

- Limited primary patency:
  - 75% at 6 mos
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
  - Banding
  - RUDI
- 4- Distal revascularization
  - Distal radial artery ligation
  - DRIL & Proximalisation
RUDI 1: PTFE distalization
PTFE Distalization
RUDI 2: Transposition of the radial artery

Cephalic/Basilic v.

Brachial artery

Transposition
Transposition of the Radial Artery

B-Basilic AVF 1500 mL/min
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
  - Banding
  - RUDI
- 4- Distal revascularization
  - Distal radial artery ligation
  - DRIL & Proximalisation
Distal Artery Ligation (distal AVF)
Treatment options

- 1- AVF ligation
- 2- PTA for artery stenosis
- 3- Fistula flow reduction
  - Banding
  - RUDI
- 4- Distal revascularization
  - Distal radial artery ligation
  - DRIL & Proximalisation
DRIL (Schanzer 1988)

Distal Revascularisation

Interval Ligation

Retrograde Flow
DRIL

Before

After
DRIL

Basilic superficialisation

Distal revascularization
DRIL - magnetic resonance angiography

Interval ligation

Distal revascularization
## DRIL results

<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Pts.</th>
<th>Limb salvage</th>
<th>1-year Primary Patency</th>
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<tbody>
<tr>
<td>1992</td>
<td>Schanzer</td>
<td>14</td>
<td>95%</td>
<td>84%</td>
</tr>
<tr>
<td>1997</td>
<td>Berman</td>
<td>21</td>
<td>100%</td>
<td>94%</td>
</tr>
<tr>
<td>2006</td>
<td>Tynan-Cuisinier</td>
<td>55</td>
<td>90%</td>
<td>86%</td>
</tr>
<tr>
<td>2008</td>
<td>Huber</td>
<td>61</td>
<td>90%</td>
<td>77%</td>
</tr>
</tbody>
</table>
Proximalisation of the arterial inflow (PAI)

Gradman & Pozrikidis 2004
Proximalisation of the arterial inflow (PAI/PAVA)
PAI Zanow 2006:

- 30 patients, HAIDI with limited fistula flow:
  - < 800 mL/min (AVF),
  - < 1000 mL/min (Grafts)

- Efficacy 84%

- Primary and secondary patency
  - 87% and 90% at 1 year
  - 67% and 78% at 3 years
PAI

☐ Pros:
- Same hemodynamics as DRIL
- Large vessels → easy sutures
- No brachial artery ligation

☐ Cons:
- Proximal artery → high-flow risk
- Graft → venous anastomosis stenosis
- No recent reports
HAIDI
Algorithm for treatment
Grade 1-2a: Conservative trt.

Grade 2b-3-4a: Duplex/Angiography

Grade 4b: Access ligation

Artery stenosis?

Yes: PTA

Access flow mL/min

<400: PAI

400 to 800: DRIL

>800: RUDI

No: Proximal AVF

Grade 1-2a: Conservative trt.

Grade 2b-3-4a: Duplex/Angiography

Grade 4b: Access ligation

Artery stenosis?

Yes:

PTA

No:

Access flow mL/min

<300: AVF ligation

300 to 600: DRAL

>600: PRAL

Distal AVF
Conclusion

- PTA is the first option
- Banding results are controversial
- DRIL is a most efficient treatment
- PAI: large anastomoses, high-flow risk, PTFE
- Access ligation may be necessary.