Management of Hemodialysis Access Induced Distal Ischemia (HAIDI)

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Disclosure

• Speaker name:
  
• Prof. Hesham Aly Sharaf El-Din

I do not have any potential conflict of interest
Introduction

• ≈ 5% of patients with upper limb AVF develop ipsilateral hand ischemia, recently termed “Hemodialysis Access Induced Distal Ischemia” (HAIDI) (Scheltinga M., et al., 2009).

• Acute, Sub-acute or Chronic patterns may occur with time of onset <24 h, 1-30 days or > 1 month after construction respectively (Vaes R. and Scheltinga M., 2012).
Introduction

- Pathophysiology is incompletely understood and may include:
  - Atherosclerosis,
  - Recurrent Intradialytic Hypotension,
  - Ongoing AVF Maturation and
  - Steal ‘flow reversal’ *(Scheltinga M. and Bruijninckx C., 2012).*
Introduction

• Different Revisional Surgeries were developed:
  ✓ Distal revascularization interval ligation (DRIL),
  ✓ Revision using distal inflow (RUDI),
  ✓ Proximalization of arterial inflow (PAI),
  ✓ Distal radial artery ligation (DRAL),
  ✓ Side Branch Ligation (SBL) and
  ✓ Banding.
Methods

• Demographic data and Co-morbidities were collected.

• Clinical data were collected as regard;

✓ Type of access and onset creation.

✓ Onset, course and duration of ischemic manifestations.

✓ Presence or absence of upper limb PAOD.
Methods

- Clinical Examination Includes:
  - Examination of the Present access.
  - Distal Pulse of both upper limbs.
  - Ischemic Signs (pallor, robar, coldness, pulselessness, trophic changes, minor or major tissue loss).
Methods

All cases underwent **duplex** assessment on AVF stressing on:

✓ Patency of the **anastomosis**, 

✓ Patency of the **venous side of the access**, 

✓ **Arterial tree patency** proximal and distal to the AVF, 

✓ Proximal and distal Peak systolic velocity (**PSV**), 

✓ Venous Flow velocity (**VFV**) and 

✓ Presence or absence of **Flow Reversal** (**Steal**)
Management Protocol

• Patients in this study are classified as acute, sub-acute or chronic cases.

• Chronic HAIDI patients are subdivided according to analogous classification to Fontaine classification including symptoms, signs and therapeutic approach for each stage.
<table>
<thead>
<tr>
<th>HAIDI GRADE</th>
<th>Clinical presentation</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAIDI Grade I</td>
<td>Vague symptoms, mild cyanosis nail beds, mild skin coldness, reduced distal pulsations.</td>
<td>Conservative.</td>
</tr>
<tr>
<td>HAIDI Grade II</td>
<td>Complain during dialysis or intense use of hand.</td>
<td></td>
</tr>
<tr>
<td>IIa</td>
<td>Tolerable pain, cramps, parasthesias, numbness or disturbing coldness in fingers or hand.</td>
<td>Conservative.</td>
</tr>
<tr>
<td>IIb</td>
<td>Intolerable pain, cramps, parasthesias, numbness or disturbing coldness in fingers or hand.</td>
<td>Conservative and invasive treatment (endovascular or surgical).</td>
</tr>
<tr>
<td>HAIDI Grade III</td>
<td>Rest pain, motor dysfunction of fingers or hand.</td>
<td>Invasive treatment supported by conservative measures.</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>HAIDI Grade IVa</td>
<td>Minor tissue loss (Hand function is maintained if ischemia is reversed).</td>
<td>Invasive treatment supported by conservative measures.</td>
</tr>
<tr>
<td>HAIDI Grade IVb</td>
<td>Major tissue loss (Impossibility to preserve function).</td>
<td>Ligation. Amputation is required.</td>
</tr>
</tbody>
</table>

Clinical classification of HAIDI (*Scheltinga M. et al., 2009*).
Inclusion Criteria:

- All Patients with Brachial artery and Distal artery based AVF; suffering from chronic HAIDI-IIb, HAIDI-III and HAIDI-IVa were considered in this study.

- Acute and sub-acute non-thrombotic HAIDI cases were also considered in this study.
• Exclusion Criteria:

- Chronic HAIDI-I and HAIDI-IIa were excluded from this study.
- Acute and Sub-acute thrombotic HAIDI were excluded from this study.
Patient Selection

- Patients were selected to surgical procedure (RUDI, DRIL, PAI or Banding) according to anatomical and pathophysiological considerations.
- Patients with multiple or single side branches were exposed to SBL either alone or with other revisional procedure.
- Patients with distal radial artery based AVF were exposed to DRAL.
Case (1): Multiple SBLs (7 SBs) including basilic vein for patient with HAIDI-III.
Distal Revascularization Interval Ligation

Case (2): DRIL in HAIDI-IVa patient using upper limb vein graft.

A; Ischemic ulcer at left ring finger tip.

B; Dissecting the vein, brachial, radial and ulnar arteries.
C; Performing the proximal and the distal anastomosis and ligating the interval.
Case (3): DRIL for HAIDI-IVa using PTFE graft. (A; dry gangrene of right middle finger. B; dissecting vein, brachial, radial and ulnar arteries).
**C:** Proximal and distal anastomosis after being performed without interval ligation.
Proximalization of Arterial Inflow (PAI)

Case (4): PAI using PTFE graft for HAIDI-III. Complete healing of cutaneous dry gangrene after 35 days.
Revision Using Distal Inflow (RUDI)

Case (5): RUDI for HAIDI-IVa using reversed GSV. (A; cutaneous dry gangrene left index finger tip. B and C; distal arterial target anastomosis and the venous anastomosis before (B) and after (C) ligating the previous inflow.
Case (6): Banding procedure for HAIDI grade III.
## Results

### Clinical Grade of HAIDI

<table>
<thead>
<tr>
<th>Type</th>
<th>%  (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic HAIDI-IVa</td>
<td>54% (15).</td>
</tr>
<tr>
<td>Chronic HAIDI-III</td>
<td>39% (11)</td>
</tr>
<tr>
<td>Subacute</td>
<td>7% (2)</td>
</tr>
</tbody>
</table>
Results

- 30 surgical interventions were performed during this study.

<table>
<thead>
<tr>
<th>Operative Techniques</th>
<th>Total no = 30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>DRAL</td>
<td>2</td>
</tr>
<tr>
<td>DRIL</td>
<td>12</td>
</tr>
<tr>
<td>RUDI</td>
<td>4</td>
</tr>
<tr>
<td>PAI</td>
<td>2</td>
</tr>
<tr>
<td>Banding</td>
<td>6</td>
</tr>
<tr>
<td>SBLs</td>
<td>2</td>
</tr>
<tr>
<td>Ligation</td>
<td>2</td>
</tr>
</tbody>
</table>

Operative Techniques among the Studied Group.
## Results

### Primary Indication of Surgery

<table>
<thead>
<tr>
<th>Variable</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest Pain</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Ischemic Tissue Loss</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>Motor Affection</td>
<td>19</td>
<td>63.3</td>
</tr>
<tr>
<td>Neurosensory affection</td>
<td>8</td>
<td>26.7</td>
</tr>
<tr>
<td>Chronic III</td>
<td>11</td>
<td>36.7</td>
</tr>
<tr>
<td>Chronic IVa</td>
<td>17</td>
<td>56.6</td>
</tr>
<tr>
<td>Subacute</td>
<td>2</td>
<td>6.7</td>
</tr>
</tbody>
</table>
### Results

#### Preoperative Duplex;

<table>
<thead>
<tr>
<th>Duplex Finding</th>
<th>Study group (n=28)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>Flow Reversal (Steal)</td>
<td>13</td>
</tr>
<tr>
<td>Distal PVD</td>
<td>6</td>
</tr>
<tr>
<td>Proximal PSV</td>
<td>245 (80-543) cm/sec</td>
</tr>
<tr>
<td>Distal PSV</td>
<td>30 (15-95) cm/sec</td>
</tr>
<tr>
<td>VFV (ml/min)</td>
<td>2061.95±622.42 ml/min</td>
</tr>
</tbody>
</table>

- With non-significant difference between different types of interventions.
Results

Graft patency

Life Table Analysis of graft patency shows:
- 93% - 6 MONTH
- 88% - 12 MONTHS
- 59% - 24 MONTHS
Results

Graft patency

Kaplan Meier Analysis of graft patency showing 20 months median Autogenous graft patency and 12 months median PTFE graft patency (P-value 0.06, non-significant).
Conclusion

- The ultimate decision in choosing re-intervention for HAIDI treatment depends on:
  - Surgeon experience,
  - Understanding the hemodynamics of the present fistula,
  - Anatomic considerations and
  - Present comorbidities.
Conclusion

- Banding procedure is considered the **first choice** as it is;
  - Simple and Least invasive.
  - Suitable with large diameter venous side.
  - No arterial interference.
  - Equal short term results to other more difficult procedures.
Conclusion

- **RUDI** have demonstrated advantages over **DRIL** as:
  - Greater reductions in **VFV** thus it is more preferred in high flow AVF (over 2000 mL/min).
  - Avoiding axial artery ligation.

- In contrast, **DRIL** is preferred in:
  - Low flow rates (800 mL/min).
  - Severe peripheral occlusive disease.
Conclusion

- Also, low flow AVFs could be treated by PAI especially in the absence of significant PAOD.

- Its only limitation is the use of PTFE graft which makes DRIL preferred than PAI in this condition.
Conclusion

- SBL procedure has a specific indication;
  - Presence of one or more significant SB within 3-5 cm from the AVF.
  - Intraoperative pulse ex. or intraoperative duplex determine whether patient needs another simultaneous procedure or SBL alone is enough.
Conclusion

- DRAL is specific for distal radial artery based HAIDI.

- Patency of the UA and palmar arch is a must (Allen’s test and duplex).

- It is contraindicated with PAOD of the UA or palmar arch.
Thanks

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