Access failure: Early and Late

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Treatment Options

- **Endovascular**
  - Lytic Therapy
  - Percutaneous Mechanical Thrombectomy
  - Angioplasty and Stenting of Stenotic Lesions

- **Open**
  - Thrombectomy
  - Open Angioplasty and Stenting of Stenotic Lesions
  - Patch Angioplasty
  - Replacement of Stenotic or Diseased Graft

- **Combination of both: Hybrid**
TREATMENT OF ACCESS COMPLICATIONS

• Problems developing in the early period after AVF construction (first 6 months) should be promptly addressed.
  • A program should be in place to detect early access dysfunction, particularly delays in maturation.
  • The patient should be evaluated no later than 6 weeks after access placement.

• **Persistent swelling** of the hand or arm should be expeditiously evaluated and the underlying pathology should be corrected.
Indications for Intervention

• Intervention on an AV Access should be performed for the presence of:
  – Inadequate flow to support the prescribed dialysis blood flow ( < 600 ml/min)
  – Hemodynamically significant venous outflow stenosis (usually intimal hyperplasia)
  – Aneurysm formation in a primary fistula.
  – Pseudoaneurysmal dilatation in an AVF or AV Graft
  – Ischemia in the access arm.
  – Infection
Location of Hemodialysis-Related Stenoses

- Subclavian: 6%
- Axillary: 2%
- Central basilic: 8%
- 1 cm to venous anastomosis: 11%
- Venous anastomosis: 47%
- Arterial anastomosis: 4%
- Midgraft: 2%
- Peripheral basilic: 19%
Indications for Intervention

• A fistula with a greater than 50% stenosis in either the venous outflow or arterial inflow, in conjunction with clinical or physiological abnormalities, should be treated with PTA or surgical revision.

• Thrombectomy of a fistula should be attempted as early as possible after thrombosis is detected, but can be successful even after several days.
Asymptomatic Stenoses

• No convincing evidence exists showing that repair of an asymptomatic anatomic stenosis (>50% diameter reduction) improves function or delays thrombosis of the vascular access.

  – Therefore, prophylactic treatment of a stenosis that fulfills the anatomic criteria (>50% diameter reduction), but is not associated with a hemodynamic, functional, or clinical abnormality, is NOT warranted and should not be performed.
KDOQI Guideline 4
Treatment of Stenoses

Stenoses should be treated if:

Clinical or physiologic abnormality
- decreased access blood flow (<600ml/min, decrease in flow)
- elevated venous pressure
- decreased dialysis dose (Kt/V)
- abnormal physical exam

+ Anatomic abnormality
  - > 50% stenoses
Extremity edema

- Patients with extremity edema that persists beyond 2 weeks after access placement should undergo an imaging study (including a fistulogram) to evaluate patency of the central veins.

- The preferred treatment for central vein stenosis is PTA.

- **Stent placement should be considered in the following situations:**
  - Acute elastic recoil of the vein (>50% stenosis) after angioplasty.
  - The stenosis recurs within a 3-month period.
Diagnosis

- **Physical Exam**
  - limb edema
  - collateral veins
  - pulsatility of access
  - access bleeding after dialysis
  - failure of new access to mature

- **Ultrasound ?**

- **Fistulogram**
Balloon Angioplasty
• Treatment of a dialysis catheter associated central venous stenosis in a patient with a maturing AV Access.

• **Consider changing the catheter site in selected cases.**
Left arm Swelling and Chronic Innominate Vein Occlusion
PTA Innominate vein occlusion
Nitinol 14 x 40 mm stent placed

Residual Stenosis needing stent placement
Right arm severe swelling involving a transposed and stenotic brachio-basilic AVF
PTA subclavian and innominate veins

Stent graft 8 x 150 mm
Stent graft 8 x 150 mm
Recurrent Left Arm Swelling

Long 7 Fr sheath for support

Engage with a Bern and a stiff glidewire
Division of Vascular & Endovascular Surgery

Crossed with a glide catheter over a straight Stiff glidewire

Select the IVC for support

PTA Innominate and Subclavian V.
Preserved collateral

8x 100 mm stent graft Viabahn

Cephalic V. stenosis

PTA Cephalic V.
Cephalic arch stenosis

- Do we look for them?
  - Only clinical monitoring.
- When to treat them?
  - Only if symptomatic.
- How to treat them?
  - Primarily endo
  - Only selective stenting
  - Open surgery in selected cases.
Indicators of risk for access rupture and need for immediate repair

• Any of the following changes in the integrity of the overlying skin should be evaluated urgently:
  – Poor eschar formation.
  – Evidence of spontaneous bleeding.
  – Rapid expansion in the size of a pseudoaneurysm.
  – Severe degenerative changes in the graft material.
Surgical revision of an Ulcerated AVF Aneurysm
Indications for revision/repair

- AVG or AVF with pseudoaneurysm or aneurysm formation should be repaired in the following situations:
  - The number of cannulation sites are limited by the presence of a large (or multiple) pseudoaneurysm(s) or aneurysm(s).
  - The pseudoaneurysm or aneurysm threatens the viability of the overlying skin.
    - The pseudoaneurysm or aneurysm is symptomatic (pain, throbbing).
  - There is evidence of infection.
Pseudoaneurysm involving a nitinol stent
CASE

• 68 year old with a left femoral AVG for 4 years who presents with increased needle site bleeding from pseudo-aneurysmal areas.

• PMHx: DM, HTN, CAD, Previous MI/PTCA, PVD, Right CLI, upper central venous occlusion, right iliac vein occlusion
Femoral AV Graft Pseudoaneurysms
6 Month Follow Up
9 Month Follow Up
Treatment of underlying central venous stenoses is required for successful therapy of AVF aneurysms
Naoum JJ, Peden EK, Bismuth J, Davies MG

Percutaneous Transluminal Angioplasties (PTA) and location of venous outflow stenoses

<table>
<thead>
<tr>
<th>Location</th>
<th># patients</th>
<th>%</th>
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<tbody>
<tr>
<td>PTA</td>
<td>21</td>
<td>81</td>
</tr>
<tr>
<td>AVF segment</td>
<td>18</td>
<td>69</td>
</tr>
<tr>
<td>Axillary or subclavian</td>
<td>12</td>
<td>46</td>
</tr>
<tr>
<td>Innominate</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>SVC</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>≥ 2 lesions</td>
<td>11</td>
<td>42</td>
</tr>
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ONE STAGE ANEURYSMORRHAPHY. (A) APA AVF exposure. (B) aneurysmorrhaphy. (C) Skin closure. This patient required a tunneled dialysis catheter until AVF was ready for use.

TWO-STAGE ANEURYSMORRHAPHY. (A) Arrows: APA AVF. (B) Bracket: repaired 1st APA and arrow: remaining APA. (C) Brackets: completed repair. This patient maintained use of access and did not require a tunneled dialysis catheter during the repairs.
Outcome of Open Repair of Arteriovenous Fistula Aneurysms
Patel MS, Huynh TT, Peden EK, Davies MG, Naoum JJ

• There is a very high association of venous outflow stenoses and arteriovenous fistula aneurysms (AVFA).

• **Comprehensive therapy should encompass treatment of any venous outflow stenoses prior to open AVFA repair.**

• A two-stage repair may decrease TDC use in patients with multiple aneurysms.
Resection of Aneurysm and end-to-end Anastomosis
Treatment of stenosis without thrombosis

- Stenoses should be treated with angioplasty or surgical revision if the lesion causes a greater than 50% decrease in the luminal diameter and is associated with the following clinical/physiological abnormalities:
  - Abnormal physical findings.
  - Decreasing intragraft blood flow (<600 mL/min).
  - Elevated static pressure within the graft.
A “ligated” fistula that was still patent

- Focal severe stenosis.
  - Due to extrinsic compression
- Treated with open patch angioplasty
• Radiocephalic Fistula inflow stenosis.
• Treated with open revision and re-anastomosis at a more proximal site.
Early experience in the use of stent grafts to convert unusable arteriovenous fistulas into a functioning hemodialysis access.

Bavare CS, Street T, Peden EK, Davies MG, Naoum JJ

Stent grafts offer a simple and percutaneous solution to rescue, preserve and convert an unusable AVF into a functioning hemodialysis access.
TREATMENT OF ARTERIOVENOUS GRAFT COMPLICATIONS

• If angioplasty of the same lesion is required more than 2 times within a 3-month period, the patient should be considered for surgical revision if the patient is a good surgical candidate.

• If angioplasty fails, stents may be useful in the following situations:
  – Surgically inaccessible lesion.
  – Contraindication to surgery.
  – Angioplasty-induced vascular rupture.
The use of covered nitinol stents to salvage dialysis grafts after multiple failures.

Figure 1. Thrombectomy on an ePTFE graft extending from the brachial artery to the axillary vein. A. Shuntogram demonstrates a stenosis of venous anastomosis and long segment stricture of the immediate outflow tract. B. Shuntogram demonstrates patency after covered nitinol stent placement.
Treatment of thrombosis and associated stenosis

• Treatment of AV access thrombosis should be performed **urgently to minimize the need for a temporary HD catheter.**

• Treatment of AV access thrombosis can be performed by using either percutaneous and/or open surgical techniques.
  – Local or regional anesthesia should be used for the majority of patients.

• **Stenoses should be corrected** by using angioplasty or surgical revision.
Steal Syndrome

• A “physiological” steal phenomenon seen in forearm AVFs and in a greater incidence in elbow/upper-arm AVFs.
  – Physiological steal occurs in 73% of AVFs and 91% of AVGs.

• **Milder symptoms** of coldness and some pain during dialysis may occur in up to 10% of cases and fortunately improve over weeks to months.

• A decrease in distal perfusion pressures is found regularly and is more pronounced in patients with advanced arterial disease.
  – In this type of patient, occurrence of a steal syndrome seems less dependent on access flow volume than on degree of the peripheral arterial obstructive disease.
## Quantifying flow volumes in AV access with steal - a predictor?

Bavare C, Bismuth J, El-Sayed H, Huynh TT, Peden EK, Davies MG, Lumsden AB, Naoum JJ

<table>
<thead>
<tr>
<th>Type of Access</th>
<th>n</th>
<th>% with steal</th>
<th>Mean volume flow in access without steal (ml/min)</th>
<th>Mean volume flow in access with steal (ml/min)</th>
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<tbody>
<tr>
<td>Radial-cephalic forearm</td>
<td>17</td>
<td>76.5</td>
<td>887</td>
<td>1247</td>
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<tr>
<td>Brachial-cephalic upper arm</td>
<td>49</td>
<td>73.4</td>
<td>1032*</td>
<td>1701.*</td>
</tr>
<tr>
<td>Brachial-basilic upper arm transposition</td>
<td>29</td>
<td>65.5</td>
<td>1191</td>
<td>1535</td>
</tr>
<tr>
<td>AVG upper extremity</td>
<td>23</td>
<td>63.6</td>
<td>1149</td>
<td>1413</td>
</tr>
</tbody>
</table>
Steal Syndrome

• Staging according to lower-limb ischemia:
  – Stage I, pale/blue and/or cold hand without pain;
  – Stage II, pain during exercise and/or HD;
  – Stage III, pain at rest;
  – Stage IV, ulcers/necrosis/gangrene.

• It is important to differentiate the findings of hand ischemia from those of carpal tunnel compression syndrome and edema from venous hypertension.

• Noninvasive evaluation should be performed, including digital blood pressure measurement and—if available—transcutaneous oxygen measurement.
Steal Syndrome

• 78 year old with ESRD, PVD and left UE AVG. During the initial surgery the AVG Initial inflow was plicated to prevent steal and improve distal signals.

• Post op, AVG is functioning, yet the patient complains of left hand pain and coolness. Volume Flow ~ 873 ml/min
Diagnostic retrograde arteriogram via the AVG access in a patient with steal

Retrograde access of the left arm AVG

Subclavian arteriogram
Treatment of a proximal left subclavian artery stenosis

Placement of an 8 x 27 mm balloon expandable stent

Endoflation and stent expansion

Completion arteriogram
Vascular Steal Syndrome Related to an Arteriovenous Fistula (AVF) can be Treated by Simple Plication of the Venous Inflow

Patel MS, Street T, Davies MG, Nassar GM, Peden EK, Naoum JJ

Exposure of AVF inflow segment
Excision of anterior portion of AVF and primary repair
Reduced inflow
Proximalization

• Move inflow to larger vessel with more capacity for flow

• Reduce flow and increase resistance of Access
Distalization

- Bridge graft to a small distal artery after proximal fistula ligation
**Distal Revascularization Interval Ligation (DRIL)**
**Distal Revascularization Interval Ligation (DRIL)**
DRIL

- DRIL patency at 1 year 51%.
- Rate of fistula salvage following DRIL at 6 months and 1 year are 78% and 54%, respectively.
- Access can fail to mature for cannulation in 32% of patients after DRIL.
- In hospital mortality of 3% and non-fatal complication rate of 22%.
- Observed patient mortality (not related to DRIL) can vary between 16.6% and 28.5%.

Conclusions

• A program should be in place to detect access dysfunction.

• Close collaboration and communication between Nurses, Nephrologists, Interventionalists, and Vascular Surgeons is paramount.

• The use of open, endovascular and a combination of both techniques should enhance access patency and salvage.