ARTERIO-VENOUS FISTULAE

1. Fistula « Balloon Maturation »: Facts and Fiction (TF. Saad, Newark, USA)

Mature arteriovenous fistulae (AVF) follow « the rule of 6s », as defined by the National Kidney Foundation (NKF) KDOQI 2006:
• Blood flow adequate to support dialysis > 600 mL/min.
• Diameter > 6 mm.
• Depth of ~ 6 mm (5-10 mm).
• Length? The longer the AVF, the higher the propensity for needle site aneurysms.

Despite this rule, most studies report approximately 25% of AVF maturation failure rates. Yet, Dember et al. (2008) reported a 60% failure rate for AVF in a randomized controlled trial in ~ 800 patients from 9 US centers.

There are several reasons for failure:
• Diffuse disease of the proposed puncture segment.
• Local disease like focal stenosis (juxta-anastomotic, arterial, « swing-point », draining or central veins), accessory or « competing » veins.
• Other hemodynamic factors such as arterial calcifications or poor cardiac output and/or blood pressure.

Potential target for ReDVA: early detection of AVF maturation failure and investigation of the underlying mechanisms using contrast-enhanced MRI.
Voormolen et al. (2009) performed a meta-analysis of the different techniques available to treat AVF failure (12 reports, 745 patients), including interventions to improve fistula maturation. A variety of surgical and percutaneous methods have been tested: angioplasty, stenting, thrombectomy, branch vein ligation, surgical revision. Altogether, the authors obtained:

- 86% success rate in achieving functional fistulae.
- At 1 year, 51% primary patency (PP) and 76% secondary patency (SP).

**Balloon-Assisted Maturation (BAM)** consists in balloon angioplasty of the prospective puncture segment that has not matured spontaneously. The objective is to achieve acceptable vessel dilatation.

In a study by Miller et al. (2009), successful attempts were achieved in ~ 97% (118/122) of patients with either class I (6-8 mm diameter, > 6 mm deep) or class II (2-5 mm diameter) fistulae by using repeated balloon angioplasty. They classified the AVF as followed:

- Successful spontaneous maturation.
- Maturation failure without intervention.
- Maturation failure undergoing stent intervention:
  - Successful after balloon-assisted intervention.
  - Failure after balloon-assisted intervention.
  - Intermediate ie. aneurysm.

## STENTS

### 2. Stents or Stent-Grafts for Central Vein Disease (D. Hentschel, Boston, USA)

The indications of central vein (CV) stents and stent-grafts include:

- Outflow patency problem.
- Adjunct in CV thrombectomy.
- CV injury (rupture, etc).

It is key that the patient suffers from symptomatic CV disease and that angioplasty attempts failed before considering stent placement. « Do not treat the angiogram! ».

**Examples of success of non-covered stents in CV disease.** PP at 12 months:

- Vogel et al. (2004): 67% with « SMART » stents.

**Examples of success of covered stents in CV disease.** PP at 12 months:

- Kundu et al. (2011): 100% with « Fluency Plus » stents.
- Santini et al. (2012): 94.7% with « Viabahn » stents.
- Vertandig et al. (2013): 50% with « Fluency Plus » and « Viabahn » stents.
Overall, 1-year patency rates after non-covered stents (self-expanding or nitinol-containing stents) are in the 50-75% range, decreasing thereafter. Angioplasty alone has typically 1 year patency rates far lower than 50%. More successes are achieved with larger diameter stent-grafts.

The potentially deleterious consequences of stent-graft insertion are:
- Occlusion of contra- or ipsilateral veins by stent-graft with loss of future options for vascular access.
- Vein injury due to straightening of the stent.
- Usual consequences of « fixing » thrombus in an occluded segment (infection, restenosis...).
- Sizing of stents/stent-grafts (e.g. Wallstent 16 mm, Nitinol 14 mm, Viabahn 13 mm, Fluency Plus 13.5 mm).

How stiff are stents? Example of a case in which the angiogram showed that the polytetrafluoroethylene (PTFE) graft was fractured.

Are all symptomatic CV stenosis the same? Examples of cardiac device wire injury, tunneled catheter injury, balloon-angioplasty injury, direct access injury to the subclavian vein, external compression by other vascular structures...

CV stent cohort at Brigham & Women’s Hospital:
- 52 patients with 24 non-covered plus covered (NCPC) and 28 non-covered (NC) alone grafts.
- Total occlusion occurred in 10 NCPC and 15 NC grafts.
- The number requiring re-interventions were greater in NC grafts.

In summary, we need to understand the different reasons for CV stenosis to better choose the appropriate treatment.

Potential target for ReDVA: assessment of the utility of contrast-enhanced MRI to identify the causes leading to CV stenosis and to help choosing the most appropriate treatment.

3. **Covered Stents in the Management of Central Venous Stenosis** (MG. Webb, Michigan, USA)

CV stenosis is a consequence of prolonged CV catheterization and complicates efforts to provide dialysis access.

The strategies for management of CV stenosis are:
- Ignore or endure.
- Venoplasty with or without stenting.
- Replacement or ligation of the diseased vein.
- Flow reduction.

The indications for intervention are:
- Uncomfortable big (swollen) arm.
• Rupture with expanding hematoma.
• Inability or difficulty for cannulation.

A study implemented a strategy to aggressively recanalize CV occlusions when possible, with repeat venoplasty and stenting as required.

A total of 180 patients were followed-up during an average 3.9 years (maximum 7 years).

Re-intervention was indicated for limb swelling (N=21), poor flow (N=14), thrombosis (N=14), « stenosis » (N=19), elevated access pressures on dialysis (N=9), prolonged bleeding (N=1) and « other » (N=4). Moreover, 30 target lesions required re-stenting to maintain access patency.

PP of the PTFE-covered stents was similar to that of bare stents, but cumulative patency was far better, being over 90% at 3 years and over 80% at 5 years.

In summary, this study showed that CV stenosis or occlusion can be managed successfully on the long term with a program utilizing PTFE-covered stents, close monitoring, and re-intervention as indicated.

Potential target for ReDVA: assessment of the utility of contrast-enhanced MRI to monitor the maintenance of patency after CV stenting (i.e. post-operatively).


The national population of the UK is 63 M people. The prevalent population receiving renal replacement therapy (RRT) is 52,000 with a prevalent annual growth rate of 3.7%.

When compared to other countries, UK records a lower incidence and prevalence of patients requiring RRT. It is also characterized by later referrals and lots of people starting with a central line whereas it has been demonstrated that the mortality rate associated with central vein catheters is significantly higher than with AVF (Polkinghorne et al. 2004).

However, transplant figures have increased by 50% in the last 5 years (2008-2013). So did dialysis prevalence. Since 2012, a national effort on prevention has started. Every patients older than 55 have their eGFR calculated. Prevention and referral pathways have been optimized according to the recommendations of the NKF.

An incentive plan with new national targets has been defined:
• 67% of incident patients should start dialysis with a proper vascular access.
• 80% of prevalent patients should be dialyzed through a proper vascular access.
• Nephrologists are in charge of their patients and get named and shamed with systematic review of each case not having a proper access.
• If not achieved, national tariff will dock 30% of annual cost per patient ($10,000).
Audits will be performed and the practice will have to be amended if the results of a specific hospital are below the standards.

**ARTERIO-VENOUS GRAFTS**

5. **Mythbuster Part 1: Are Grafts as « Bad » as we think?** (DL. Cull, Greenville, USA)

Murad MH. et al. (2008) performed a meta-analysis of autogenous (AVF) versus prosthetic (AVG) vascular access for hemodialysis. The author reviewed approximately 80 observational studies and 3 randomized controlled trials involving close to 70,000 patients. He showed that fistulae are associated with a decreased risk of death and infection, an increased PP, fewer access-related hospital days, and fewer perioperative complications. Moreover, Huber TS. et al. (2003) showed that the percentage of patent AVF after 2 years is superior to that of patent AVG.

Altogether, previous literature suggests that fistulae are associated with greater benefits than grafts. However, this inference bears some limitations:
- There were only a few randomized clinical trials.
- There were strong methodological biases such as young male patients with good veins receiving AVF whereas elderly females with disadvantaged anatomy were allocated AVG.
- The conclusions were based on small patient numbers.
- Early failures or interventions were excluded from the analysis.

Lok CE. et al. (2013) showed that cumulative patency did not differ between fistulae and grafts when including early failures, i.e. that there was much less benefit of AVF than expected. However, AVG required more interventions to maintain functional patency.

Disbrow DE. et al. (2013) found that grafts and fistulae achieve similar rates of SP and that the number of interventions required to maintain patency does not differ between both treatments. On the other hand, the number of catheter days to first access use was more than doubled for AVF as compared to AVG. They concluded that a « fistula first » approach might not always apply to patients who are already on dialysis via catheters when referred for chronic access placement.

Al-Jaishi AA. et al. (2014) showed that in 2000-2012, the rates of primary failure of forearm fistulae have worsen (28% vs 15%) and the rates of PP at 1 year have decreased (55% vs 62%) in comparison to those reported by Rooijens PP. et al. (2004) in 1970-2002.

In summary:
- Once an AVF is successfully cannulated, it provides the advantages of lower rate of thrombosis, fewer interventions to maintain patency, lower rate of infection, and lower cost.
• Efforts to « maximize » AVF prevalence without regard for patient selection likely negates the benefits of AVF.
• AVF prevalence is a surrogate marker for measuring vascular access quality. Most important is PP, SP, number of interventions required to maintain functionality, accessibility, access-related infection rate, access-related morbidity, and access-related mortality.
• Focus needs to shift from achieving AVF prevalence to placing the right access in the right patient at the right time.

Potential target for ReDVA: assessment of the utility of contrast-enhanced MRI to select the patients who will benefit the most from AVF implantation, i.e. to predict the success of the treatment.

CARDIAC ISSUES IN ARTERIO-VENOUS ACCESS

6. Cardiovascular Implantable Electronic Devices (CIEDs) and Hemodialysis Access (H. Wasse, USA)

CIED prevalence in end-stage renal disease (ESRD) patients is estimated ~ 10% (Charytan DM. et al. 2011). CIEDs confer mortality benefit in ESRD. However, special considerations for hemodialized patients with CIED are CV stenosis and high rate of infections.

Teruya TH. et al. (2003) reported symptomatic subclavian vein access stenosis or occlusion in 10/14 patients with ipsilateral pacemaker placement. Traditional CIED lead insertion route is transvenous (subclavian vein or cephalic vein). CV stenosis can occur at vein puncture site or any point in contact with CIED leads. The primary approach for treatment is angioplasty without stent placement. Moreover, device-associated infection with significant 90-day mortality is higher in hemodialized than in non-hemodialized patients (Hickson LJ. et al. 2014).

Prevention of CV stenosis is key for ESRD patients with vascular access who received a CIED and it is important to weigh up benefits and risks, including impact on current or future arterio-venous access. Careful selection of veins for CIED leads, with avoidance of ipsilateral subclavian vein to existing or planned arterio-venous access will reduce the likelihood of CV stenosis. Epicardial CIED may provide a solution for ESRD patients in certain circumstances.

VENOUS HEMODIALYSIS CATHETERS

There are two major issues with catheter: 1) infection and thrombosis and 2) CV stenosis.

Long-term catheter complications:
- Incidences of CV stenosis of 11-40% are reported.
- They manifest themselves by extremity, chest, neck and facial swelling.
- No successful long-term treatment is available.
- They are responsible for loss of permanent vascular access in the upper extremity.

Salik et al. (2007) showed how 3D anatomy of the left CV can help for CV catheter placement. Kohler TR. et al. (1998) also showed that CV access failure is induced by vessel injury and can be prevented by stabilizing the catheter tip.

Potential target for ReDVA: assessment of the utility of contrast-enhanced MRI for CV catheter placement.

**ABSTRACT SESSION**

8. *Venous Stenosis of Brachiocephalic Fistula: a Single Entity, or is the Cephalic Arch Different?* (AJ. Jackson, Glasgow, UK)

Cephalic arch stenosis (CAS) is an important cause of brachiocephalic fistula (BCF) failure. However, the optimal management strategy is not defined. The aim of this study was to compare presenting features and angioplasty outcomes in cephalic arch compared to other types of venous stenosis affecting BCF.

A total of 59 patients underwent angioplasty for CAS (N=16), low venous outflow (N=22) or swing segment (N=21). There was no difference in PP at 3, 6, and 12 months between the 3 groups but there was a higher number of interventions in the group with CAS.

Conclusion: CAS hallmark is the requirement for repeated re-intervention.

Best regards,

Eric Lancelot