Indications and Options for Endovascular Therapy

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How High Is Too High?

- Currently, there are no guidelines for when and at what access flow (Qa) or Qa/CO ratio (CPR) one should intervene
- Most reports in the literature have done so when:
  - Patients develop frank symptoms of CHF
  - Qa $\geq$ 2 L/min
  - CPR of 30 to 35%
- The Vascular Access Society guidelines define a high Qa AVF as one that has a Qa of 1.0–1.5 L/min and a CPR >20%

- However, some have suggested that in view of the fact that the vast majority of patients tolerate this level, it is too low
- One study showed that:
  - Qa values ≥2.0 L/min - sensitivity 89%, specificity 100%, ROC curve area 0.99
  - CPR values ≥20% - sensitivity 100%, specificity 74.7%, ROC curve area 0.92

Basile C, et al. Nephrol Dial Transplant 23: 282-287, 2008

Another Metric – Cardiac Index

- The normal range of cardiac index in rest is 2.6–4.2 L/min/m^2
- Cardiac index >4.2 L/min/m^2 means high cardiac out-put
- Any patient with intractable or worsening heart failure symptoms despite medical therapy should undergo assessment for high-output cardiac failure

Patient Selection for Treatment

- First institute a program of maximum medical management
- Control of factors that might lead to or complicate a predisposition to heart failure - anemia, hypertension, over-estimated dry weight
- If clinical signs of heart failure persist after solving these problems, it is reasonable to intervene to correct an AVF with a persistently high Qa (≥ 2.0 L/min) or in the presence of a CPR ≥ 30%

Mac Rae JM, et al. *Am J Kidney Dis* 43: e17-22, 2004

The Best Test

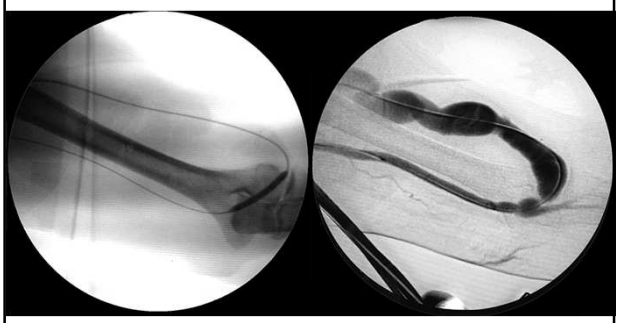
- Some have suggested that the CPR ratio which takes into account the implications of high flow rather than simply the numerical value, has greater clinical significance and is better predictive of cardiovascular risk
- Cardiac index may be a better metric than cardiac output for same reason

Management

- Be sure the patient does not have two functioning accesses – if so, close one
- Flow reduction procedure
  - Banding
  - RUDI

Balloon-Assisted Banding

- First described in 1999
  - Beathard, GA, et al. Am J Kidney Dis 1999; 33:910.
- Used for dialysis access steal syndrome (DASS)
  - Goel, N, et al. Kidney Int 2006; 70:765
- Recurrent cephalic arch stenosis
  - Miller, GA, et al. J Vasc Access 2010; 11:281
- Non-correctable central vein stenosis
  - Jennings, WC, et al. J Vasc Access 2012; 13:157.
- High output cardiac failure
  - Miller GA, et al. Kidney Int. 2010;4:359-66.

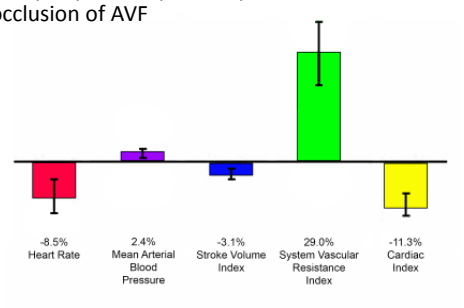


Case recognition Management Results

Results

Acute Changes with Occlusion

- Study of patients pre and post 15 minute manual occlusion of AVF



Aitkin, E, et al. J Vasc Access 2015

- 88% had a reduction in CI
- In high-flow AVFs occlusion of AVF results in ΔCI of 41.0% compared to 8.4% in other AVFs
  - 2.79 ± 0.34 L/min/m^2 vs 0.24 + 0.48 L/min/m^2

Cardiac Changes Are Reversible

- Studies done following AVF closure have shown that the adverse cardiac changes are reversible
- Changes in left ventricular hypertrophy have been shown to begin as early as 10 days following fistula ligation and continue up to 21 months

Unger P, et al. *Am J Transplant* 4:2038–2044, 2004
Unger P, et al. *Transplantation* 74:73–79, 2002
van Duijnhoven EC, et al. *Nephrol Dial Transplant* 16:368–372, 2001
De Lima J, et al. *Cardiology* 92:236–239, 1999

Is There a Risk?

- There are cases when adequate flow reduction cannot be achieved and AV access ligation is necessary
- There are reports of patients with severe heart failure where acute cardiac decompensation has occurred resulting in death after AVF ligation
- As a result of the immediate increase in peripheral vascular resistance upon AV access closure

Wasse, H, et al. *Seminars in Nephrology,* 2012; 32: 551-557

- It has been suggested that HD patients be screened for potential high-output failure using the CPR
- Cases with CPR ≥30% should undergo regular biannual echocardiographic assessment of the LV
  - LV end-diastolic and systolic dimensions
  - LV mass index **Routine Monitoring**
  - Ejection fraction
- If the patients with elevated CPR have increasing LV cavity volume and CO (or CI), then they should be considered for a fistula flow reduction

MacRae JM, et al. *Am J Kidney Dis* 43: e17-22, 2004