High Flow Fistula - When Should We Address the Flow?
ASDIN 11th Annual Scientific Meeting
Orlando, FL, February 14, 2015

Dirk Hentschel, MD
Director, Interventional Nephrology
Brigham and Women’s Hospital

Disclosure

• Consultant: Gore, Proteon Therapeutics

Access Milestones

• 1962 Brescia-Cimino Fistula conceived
• 1966 executed by Appel

First reports on recognition and treatment of high flow access...

Hamodynamic and invasive blood flowmetry in hemodialyzed patients with high blood flow fistulas.
Levy SI, Bourquelot P, Ponsin JC, Man NK, Martinoud JP.

Detection and treatment of high-output cardiac failure resulting from a large hemodialysis fistula.
Reis GJ, Hirsh AT, Come PC.

Bandaging a hemodialysis arteriovenous fistula to decrease blood flow and resolve high output cardiac failure: report of a case.
Izoda S, Fujikawa H, Komio J, Mabunori A.

High flow not an issue for many years...

Autogenous access created in 1990 (>6000 needles insertions)

Dual Outflow
flow >2000 ml/min
radial artery 8mm

What is a High-Flow Autogenous Access?

• KDOQI Vascular Access (2006)
  ★ No definition
  ★ single mention in context of AVF aneurysm formation

• EBPG on Vascular Access (2007)
  ★ “High flow access”: brachial-cubital/cephalic/basilic (upper arm)
  ★ autogenous accesses
  ★ no blood flow range
High-Flow Autogenous Accesses

- High for artery - Steal
- High for pump - Cardiovascular compromise, heart failure
- High for clearance - cardio-pulmonary recirculation
- High for access - inflow-outflow mismatch, high pressure, enlarging aneurysms
- High for patient age - transplant patients, “young” dialysis patients

#1
- Flow 1400 ml/min
- Blood pressure 146/65
- DMII, HTN, CAD, PVD
- “STEAL”

#2
- Flow 1300 ml/min
- Blood pressure 119/78
- Decompensated heart failure over course of 6 months

#3
- Flow 5900 ml/min
- Blood pressure 110/63
- Decreased URR/elevated venous pressures - cardiopulmonary recirculation

What are normal intra-access pressures (IAPs)?

Intra-Access Pressures and Needle Insertion Site Aneurysm

- 2010
- Banding
- BP 166/72
- Pre-AP: AP 83/50 (64)
- Post-AP: AP 63/39 (49)

- 2011
- 2014
- 2015
HD population at high risk:
- chronic thromboembolism from tunneled catheter (opinion)
- procedure related thromboembolism (thrombectomy - "lyse and balloon smash")
- micro- and macro- cardiovascular disease

Flow considerations

\[ \frac{dV}{dt} = \nu \pi R^2 = \pi R^4 \left( \frac{-\Delta P}{\Delta x} \right) = \frac{\pi R^4 |\Delta P|}{8\eta L} \]

<table>
<thead>
<tr>
<th>diameter</th>
<th>length</th>
<th>pressure gradient</th>
<th>blood viscosity</th>
<th>FLOW ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>40</td>
<td>2.6</td>
<td>479.88</td>
</tr>
<tr>
<td>2.5</td>
<td>1</td>
<td>40</td>
<td>2.6</td>
<td>1171.582031</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>40</td>
<td>2.6</td>
<td>2429.3925</td>
</tr>
</tbody>
</table>
Recognition of “high flow” High Flow Accesses

**Patient Characteristics**
- apparent lack of systemic vascular disease
- young age
- Access flows >2000

**Surgical and Angiographic Characteristics**
- location/diameter of inflow artery
- diameter of anastomosis (>3-4mm)
- velocity of contrast and/or its dilution
- MEASURE... (flow, artery, anastomosis)

Summary

**Treat High flow because of symptoms**
- steal - banding, DRIL, proximalization; inflow stenosis
- cardiovascular compromise - banding, ligation
- cardio-pulmonary recirculation decreasing URR,
- inflow-outflow mismatch - fix outflow +/- banding

**Prevent long-term consequences of high flow**
- “Normal” flows: forearm 850 ml/min (n=11); upper arm brachial-cephalic 1580ml/min (n=56) - depends on local surgeons...
- Think about high flow state if flows >1500ml/min, access pulsatile and without collapse after angioplasty