Glenn and Fontan Caths:

Pre-operative evaluation and Trouble-shooting

Cavo-Pulmonary Shunts

Daniel H. Gruenstein, M.D.
Director, Pediatric Interventional Cardiology
University of Minnesota Children’s Hospital, Fairview
Asst. Professor, Pediatrics
University of Minnesota Medical School

With new thinking, more is possible.
Objectives

• Pre-operative catheterization
  – What information do we need to obtain?
  – What can catheterization provide that non-invasive imaging cannot? (Do we need pre-operative caths?)

• Case studies/Discussion:
  – PA problems
  – Residual/new shunts causing desaturation
  – Collaterals (AP, veno-venous/atrial)

These are secondary effects of another problem!!!
Objectives

• Pre-operative catheterization still needed?
  – What catheterization can provide that non-invasive imaging cannot
Many Anatomical Variations – One General Principle

• General Principle – systemic venous return circumventing the heart requires “passive” flow through the pulmonary circulation
  – Low resistance
    • no pulmonary arterial obstruction
    • Low pulmonary arteriolar resistance
    • Low atrial pressure (AV valve stenosis/regurgitation)
    • Low systemic ventricular diastolic pressures
Theoretical, or actual risk?

Pre-operative factors associated with worse outcomes:

- PA obstruction/distortion
- Elevated arteriolar resistance (>2 Woods x m²)
- Elevated mean PA pressure (> 15 mmHg)
- AV valve abnormalities (L AV valve atresia, common AV valve)
- <3 years old

Factors associated with improved survival after modified Fontan operations.

Theoretical, or actual risk?

Pre-operative factors associated with worse outcomes:

• PA obstruction/distortion – better with angio?
• Elevated arteriolar resistance (>2 Woods x m²)
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Hemodynamics – PAP and Rp

• Need direct access to PA
  – Across AP shunt
    • risk of acute occlusion, thrombosis, inaccurate measurements
  – Into Glenn via IJ or subclavian
    • risk of pneumothorax/hemothorax, thrombosis

Can we avoid these risks?

What if there is no direct access?

Diagnostic cases have risks!!!
Pressure Wire
With new thinking, more is possible.
Problem - Cannot Directly Access PAs

Pulmonary Venous Wedge Pressure Provides an Accurate Assessment of Pulmonary Artery Pressure in Children with a Bidirectional Glenn Shunt

Gruenstein, DH, Beekman RH - Journal of Interventional Cardiology
Can non-invasive studies replace diagnostic caths for single-V palliation?
Cardiac Magnetic Resonance Versus Routine Cardiac Catheterization Before Bidirectional Glenn Anastomosis in Infants With Functional Single Ventricle: A Prospective Randomized Trial
Brown, DW, et al
DOI: 10.1161/CIRCULATIONAHA.107.723213

- prospective, randomized, single-center clinical trial comparing catheterization with CMR in patients considered for bidirectional Glenn
- End points - adverse events of the preoperative evaluation and a composite score of clinically successful surgery.
- 82 enrolled
- Catheterization resulted in more minor adverse events (78% versus 5%; p<0.001), longer preoperative hospital stays (median, 2 versus 1 day; p<0.001), and higher hospital charges ($34,477 versus $14,921; p<0.001).
- There was 1 major adverse event in the CMR group.
- The operative course and frequency of postoperative complications were similar between the 2 groups.
- The proportion of patients who had a successful bidirectional Glenn operation was similar (71% versus 83%; p=0.3).
- At the 3-month follow-up - no differences in clinical status, oxygen saturation, or frequency of reinterventions.
Role for Pre-cavopulmonary anastomosis catheterization

• Perhaps a decreasing role for pre-operative hemodynamics, as anatomy (PA and venous) is well assessed by CT/MR
• CT/MR may give indication of need for catheterization – PA obstruction, collaterals
• Increased role for pre-operative interventions
Role for Catheterization – Beyond pre-operative assessment

• Intraoperative/Exit Angiography
Exit Angiography
Exit Angiography

With new thinking, more is possible.
Exit Angiography

With new thinking, more is possible.
AC – s/p Glenn with desaturations
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PA stenoses

• Be Appropriately Aggressive!
• Correct them **EARLY!!!**
Typical Paradigm

Diagnostic Cath

Interventional Cath

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Single-V Paradigm

Diagnostic Cath

Interventional Cath
Connor

- HLHS variant (DORV/mitral atresia/CoA)
- s/p CoA repair/PA band (DOL #5)
- s/p DKS/BDG (6 months)
Connor

- Presented to ED 3 months after BDG
- Tachypnea
- Cough
- Facial Swelling
A pleural effusion is a sign of another problem.
With new thinking, more is possible.
With new thinking, more is possible.
Presenting issues that should prompt a search for an underlying problem

• Pleural effusions
  – contralateral PA obstruction

• Aorto-pulmonary collaterals
  – ipsilateral PA obstruction

• Veno-venous/atrial collaterals
  – cavo-pulmonary anastomosis and/or PAs
AJ – Heterotaxy, TAPVR, bilateral SVCs
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AJ – 10-27-2009 – After anticoagulation
AJ – 3-2010 – s/p Fontan revision
AJ – 3-2010 – s/p Fontan revision
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2010 Mar 05

With new thinking, more is possible.
AJ – 3-2010 – s/p Fontan revision

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AJ – desaturated 9-2011
Take-Home Messages

- Cavo-pulmonary shunts require low-resistance, unobstructed pulmonary circulations
- At the earliest evidence of PA obstruction – ACT!!! Be appropriately aggressive
Don’t just stand there – Do something!!!
Take-Home Messages

- Collaterals and effusions are the smoke – it means there is a fire (PA obstruction, high PVR, AV valve regurgitation, etc)
Take-Home Messages

• Therefore, you have to find the fire (underlying cause) and put it out, or the smoke just keeps coming back—Don’t get distracted—find the cause and treat it!
Take-Home Messages

• In the end, smoke kills just as well as fire – treat the cause and the collaterals, before a “feedback loop” starts
• Interventionalists need to take a cue from the tobacco industry – go after them early!!!