Understanding the Principles of Cardiac Catheterization

Stephen Kaine, MD

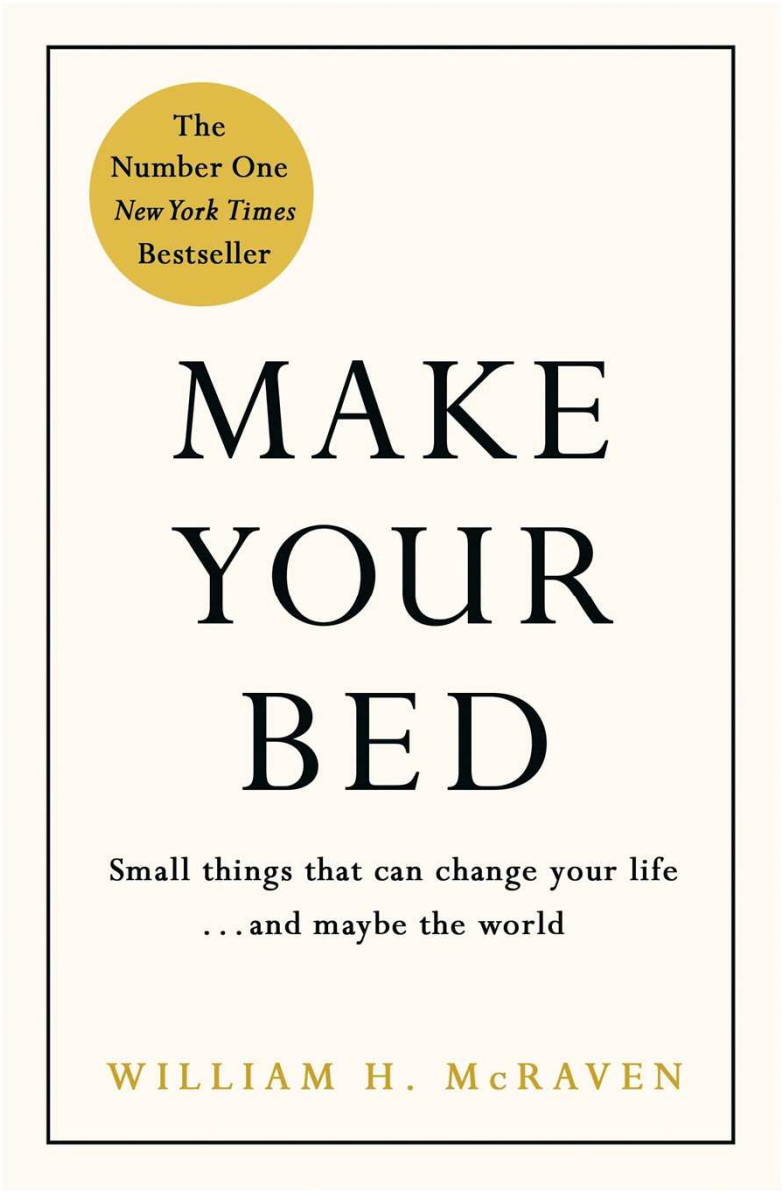
Children's Mercy Hospitals and Clinics, Kansas City, MO

Matthew Schwartz, MD

Sanger Heart and Vascular/Levine Children's Hospital, Charlotte, NC

Disclosures

- No financial relationships to disclose


The
Number One
New York Times
Bestseller
MAKE
YOUR
BED
Small things that can change your life
. . . and maybe the world
WILLIAM H. McRAVEN

Smart Choice

THURSDAY, FEB. 22

7 – 8 a.m.

Sunrise Session I (ARIZONA I-III)

Electrocardiography: How to Read ECGs and Real Cases

Mitchell Cohen, MD; Maully Shah, MBBS; Edward Walsh, MD

Sunrise Session II (ARIZONA IV)

Understanding the Principles of Cardiac Catheterization

Stephen Kaine, MD; Matthew Schwartz, MD

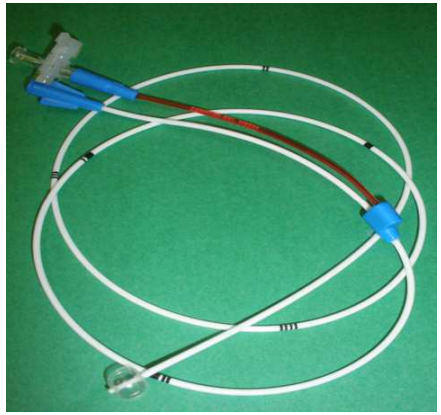
Outline (45 min)

- Brief review of catheterization basics
- Several instructive cases

How Do We Obtain Catheterization Data?

- Patient is typically put under anesthesia
- Obtain vascular access
- Advance catheters to various locations
- Using x-ray for guidance

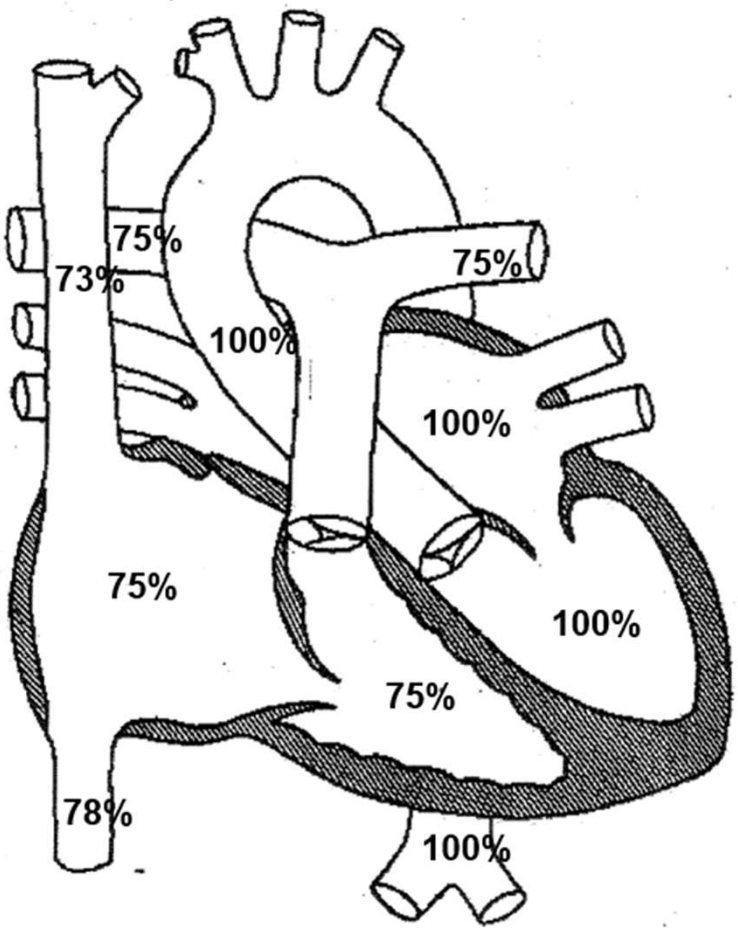



Divide the Catheterization into 4 Parts

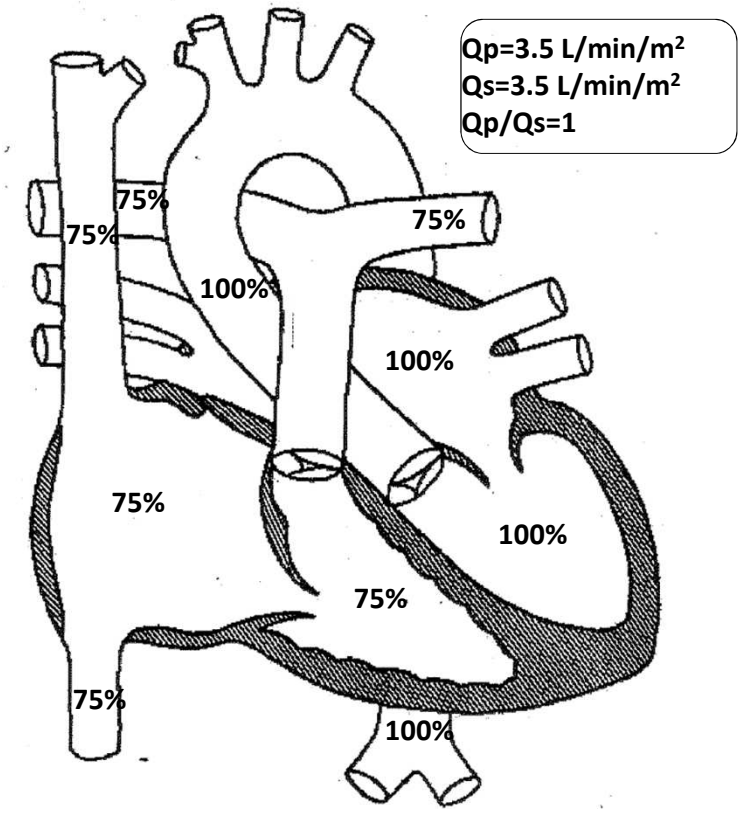
- Oximetry
  - Measure oxygen saturations
- Hemodynamics
  - Measure intracardiac/intravascular pressures
- Angiography
  - Take pictures by injecting contrast and taking x-ray movie
- Intervention
  - Close holes/blood vessels, balloon dilate/stent vessels, balloon valves, etc

Normal Oximetry



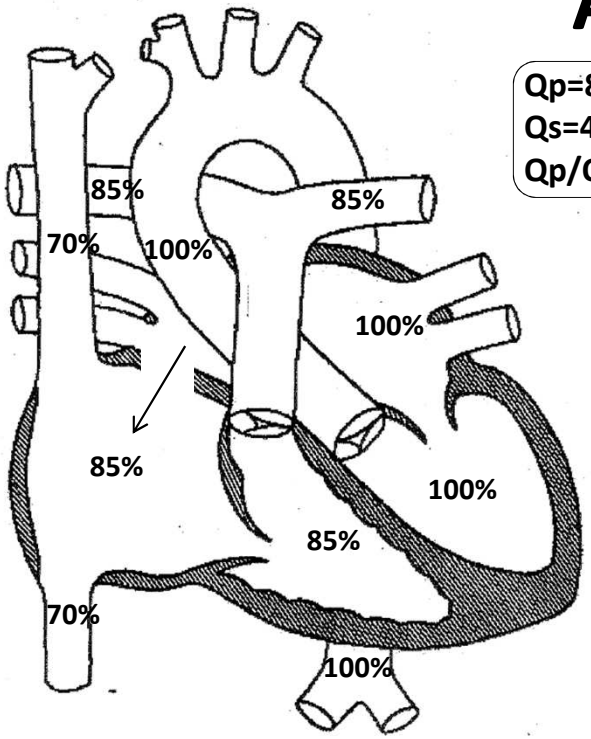
Use Saturations to Estimate Blood Flow

- Fick method
  - Use oxygen saturations to estimate flow to various places
- Qs: flow to body (cardiac output)
- Qp: flow to lungs
- If no intracardiac shunting Qp=Qs or Qp/Qs=1

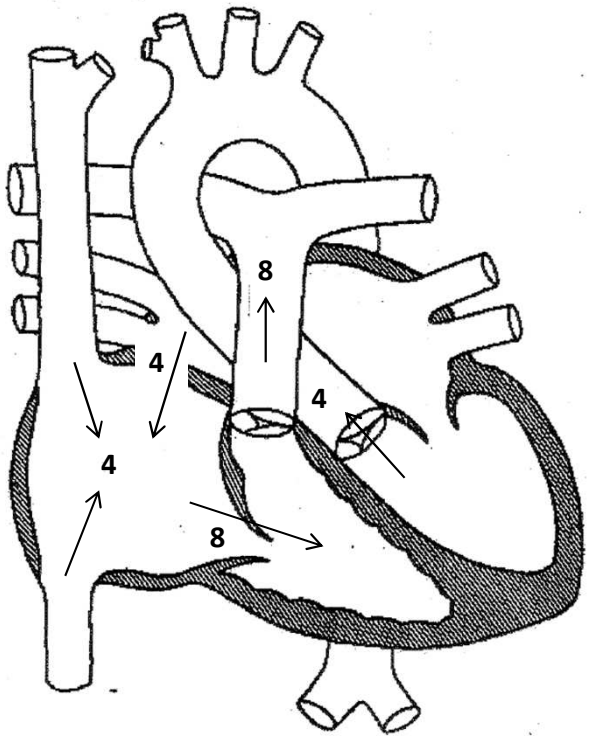


Saturations Can Detect Intracardiac Shunting and Estimate Degree of Shunting

ASD

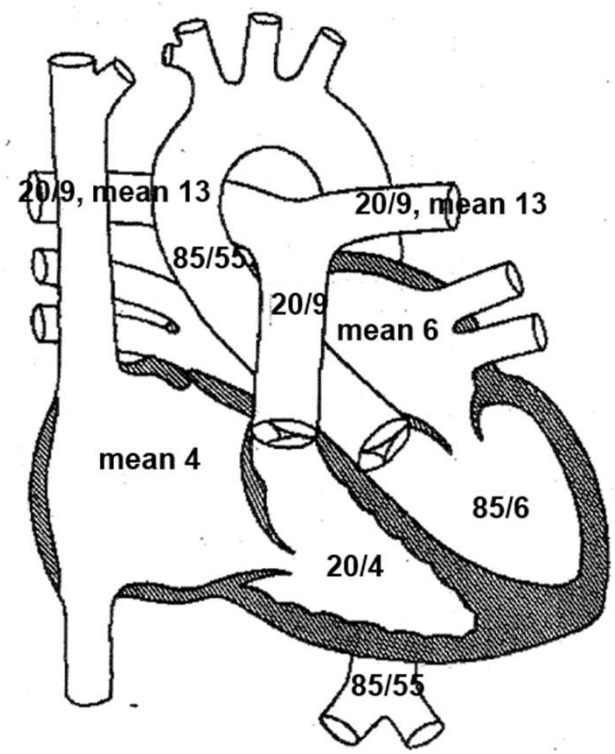


Qp=8 L/min/m2
Qs=4 L/min/m2
Qp/Qs=2



Normal Hemodynamics

- Arteries and ventricles
  - Systolic/diastolic/mean
- Veins and atria
  - Mean pressure
- Pressure “gradient” is difference in pressure between 2 structures
- For arteries/ventricles, the “gradient” refers to the difference between systolic pressure between 2 structures.
- If flow between structures is unobstructed, then there should not be a significant gradient between the structures.



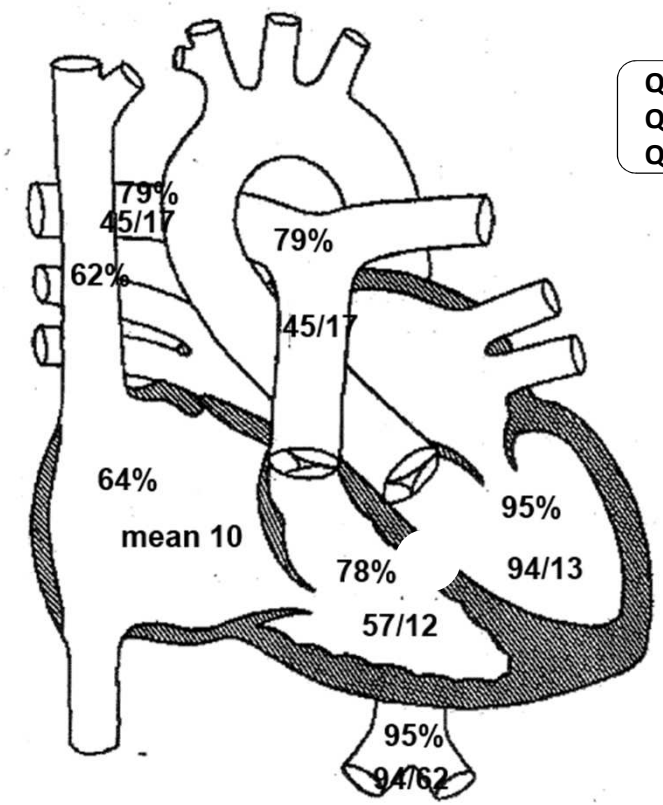
CASES

VSD

- Infant born with D-TGA and VSD
  - 1 week: underwent arterial switch operation with VSD closure
  - 4 weeks: catheterization and stents placed to right pulmonary artery and left pulmonary artery.
  - 6 weeks: still in hospital, tachypnea, poor feeding, echo suggests moderate VSD
  - Referred to cath to evaluate hemodynamic effect of VSD

Residual VSD after Surgery

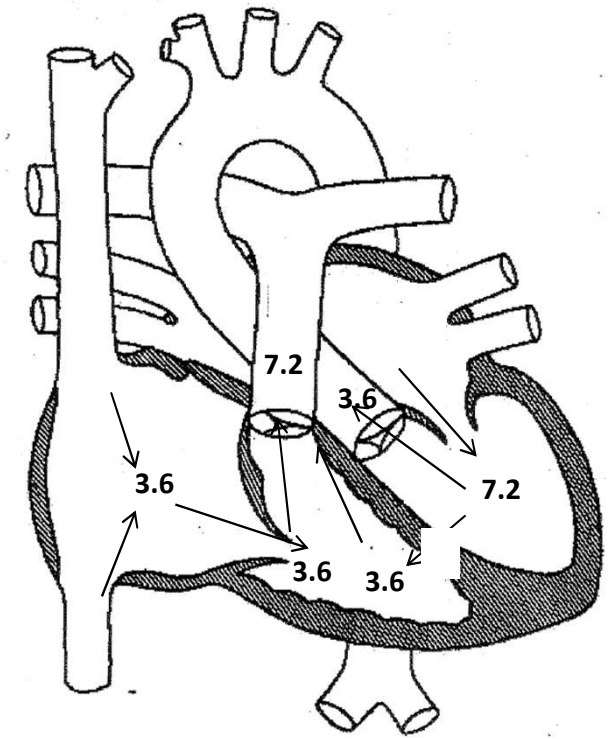
-1 wk: ASO, VSD closure
-4 wks: cath w/ PA stents
-Since, tachypnea, poor feeding
-Echo: mod residual VSD



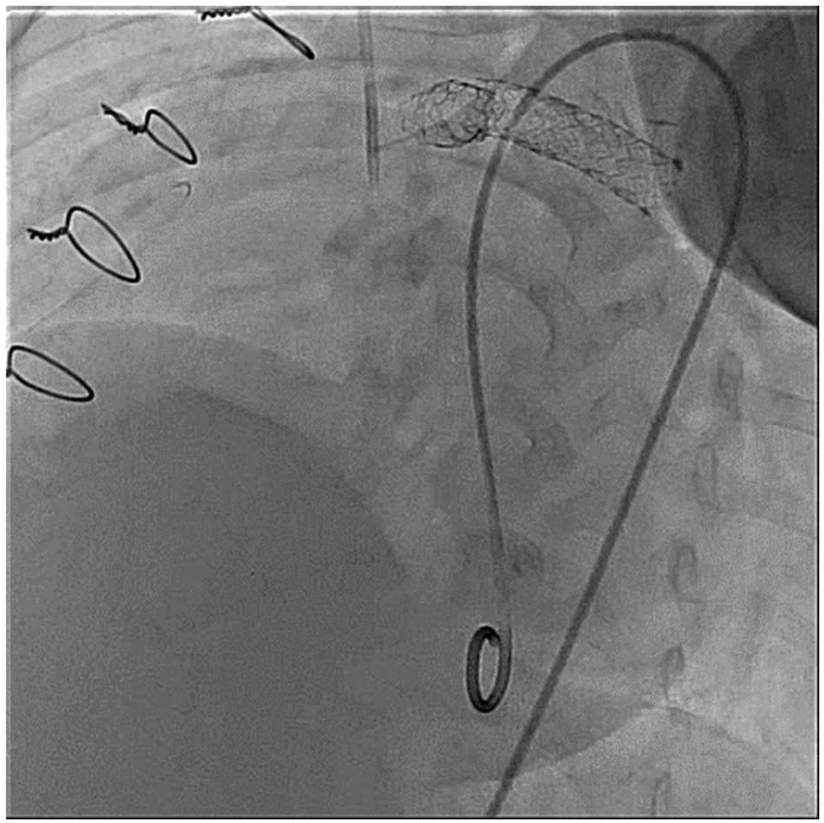
Qs= 3.6 L/min/m2
Qp= 7.2 L/min/m2
Qp/Qs= 2:1

Saturations Can Detect Intracardiac Shunting and Estimate Degree of Shunting

Qp= 7.2 L/min/m2
Qs=3.6 L/min/m2
Qp/Qs=2



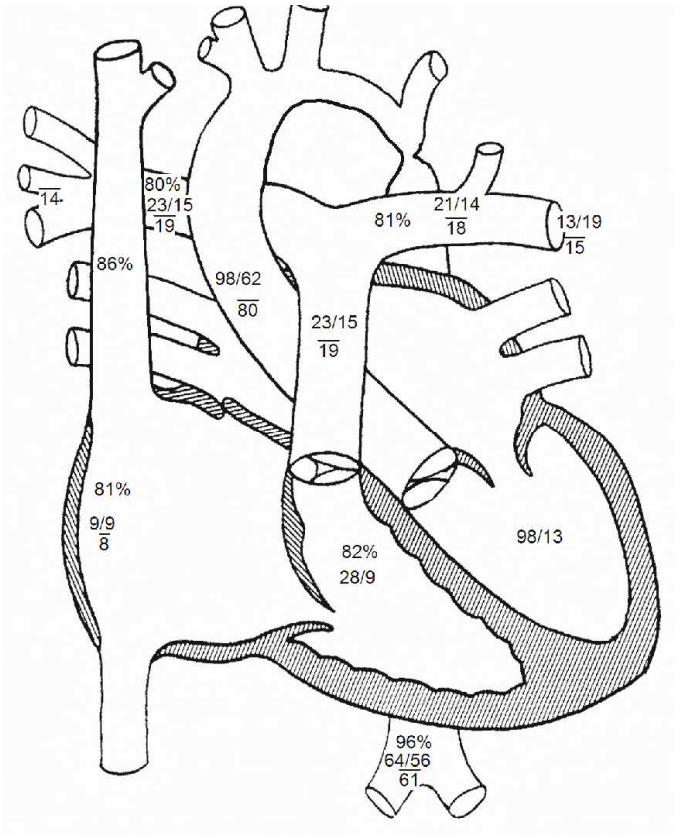
Residual VSD after Surgery



Aortic Coarctation

- 10 yo male referred to cardiology after found to be hypertensive
- TTE suggested severe coarctation
- Referred to catheterization to consider stent placement

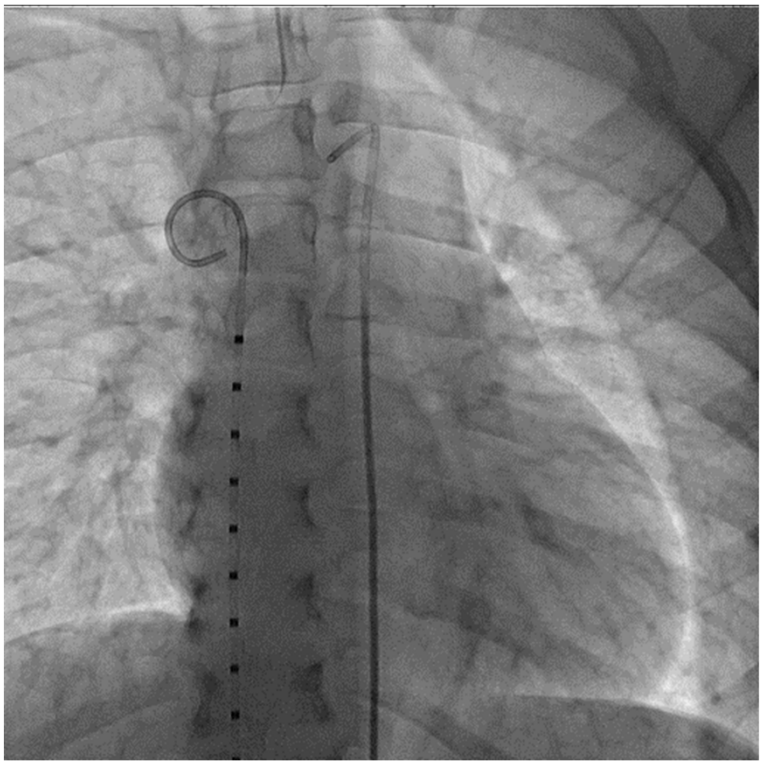
Aortic Coarctation

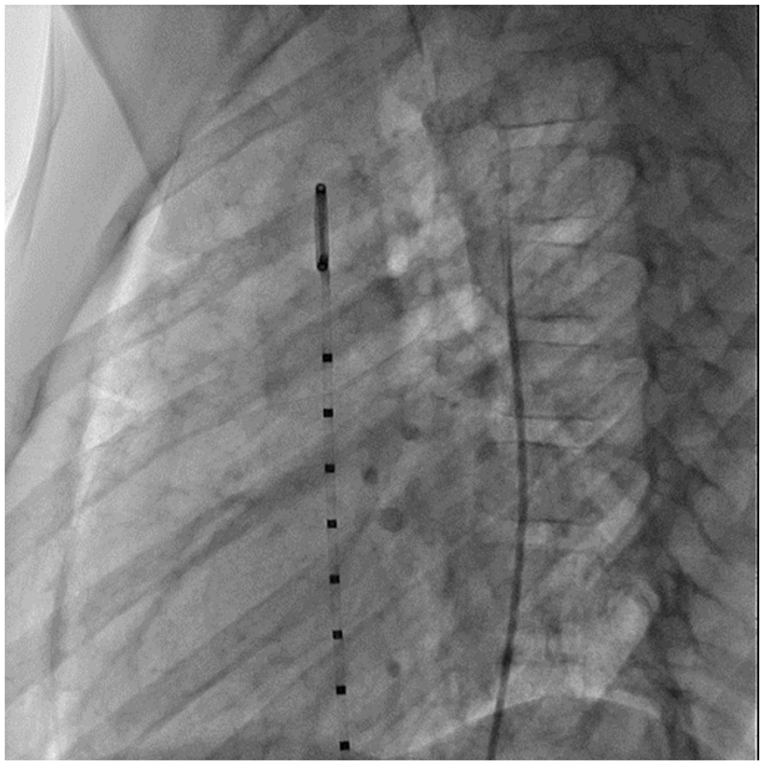


Baseline, GA, 21% FiO2

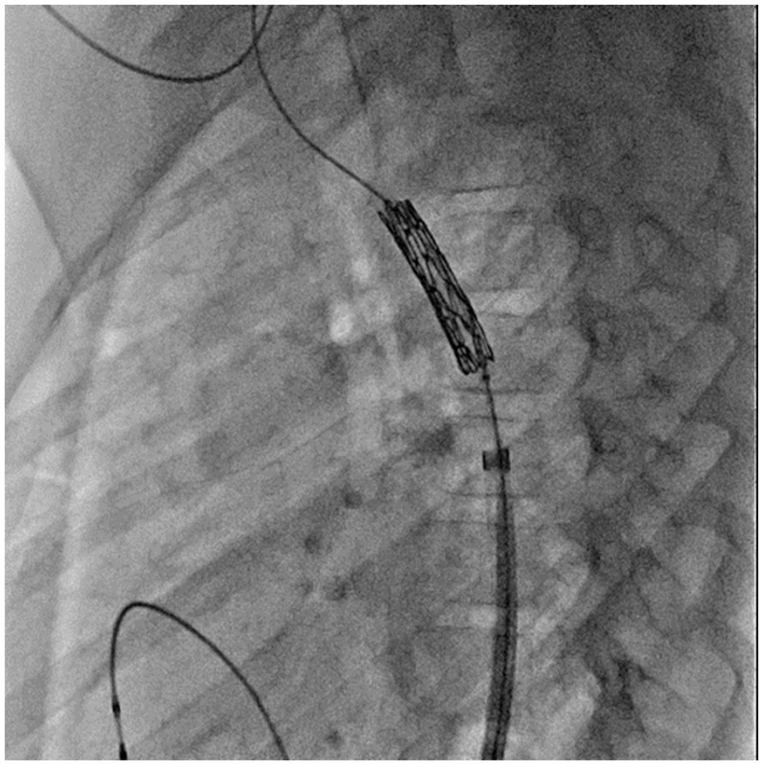
Qp = 5.86 L/min (4.92 L/min/m2)
Qs = 5.86 L/min (4.92 L/min/m2)
Rp = 0.68 units (0.81 units x m2)
Rs = 9.05 units (10.76 units x m2)
Qp/Qs = 1.00 : 1 | Rp/Rs = 0.08

Aortic Coarctation

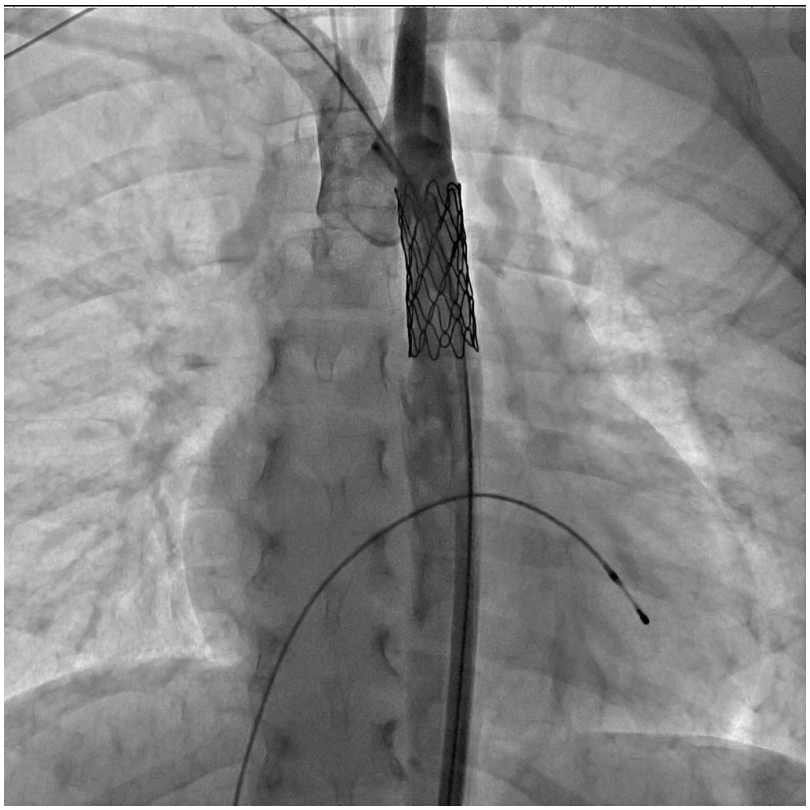


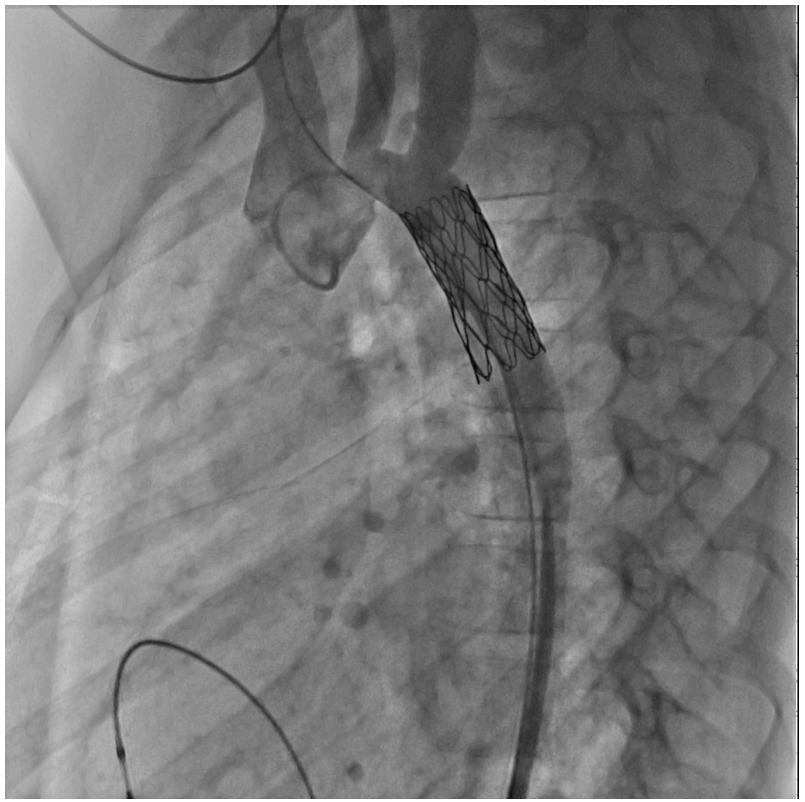


Aortic Coarctation: Stent Expansion

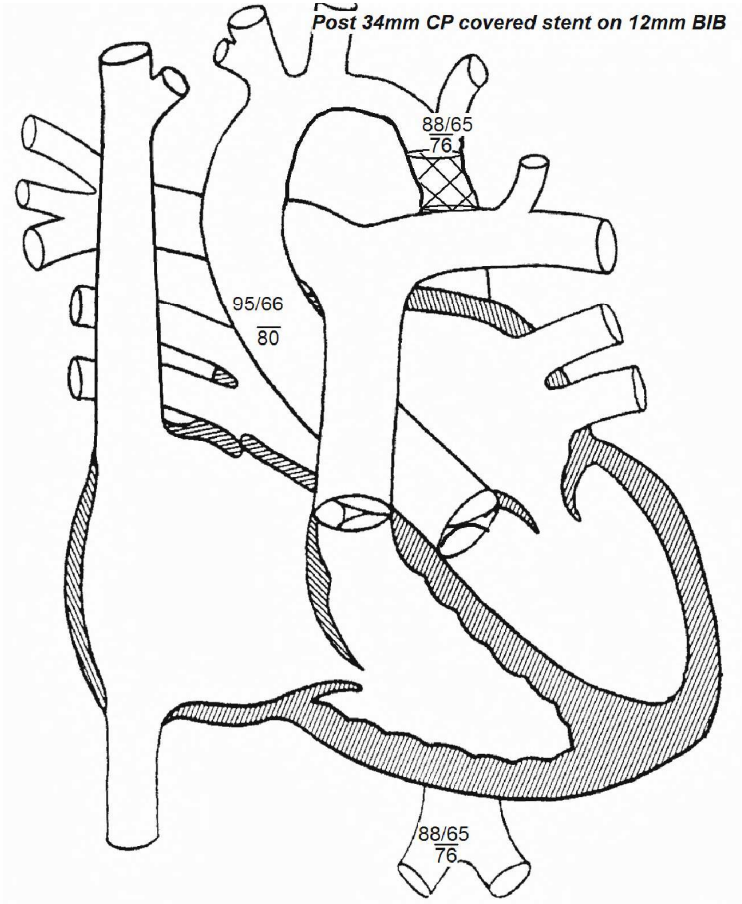


Aortic Coarctation after Stent Placement





Aortic Coarctation after Stent Placement



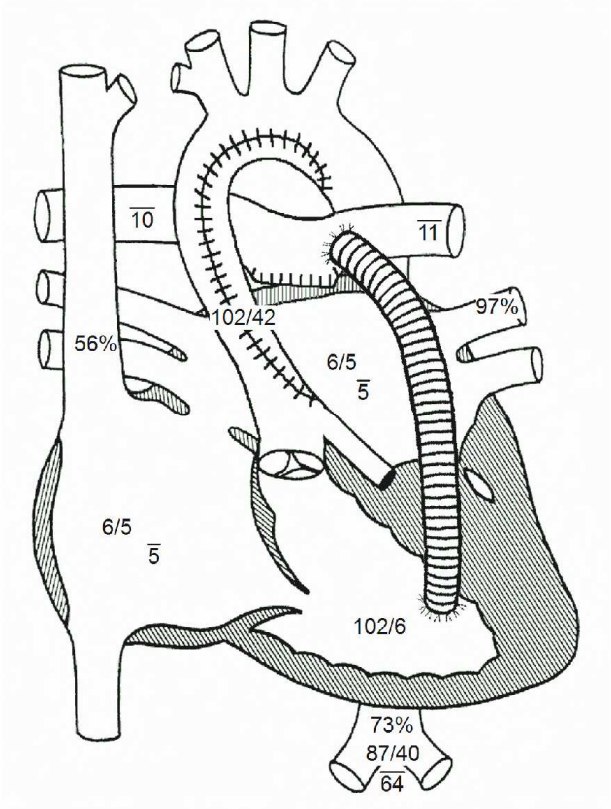
Pre-Stage 2 Catheterization

- 3 mo w/ HLHS
  - 1 wk: s/p Norwood operation with 6mm RV to PA conduit (sano)
  - Referred for catheterization prior to Stage 2
- Stage 2 (bidirectional Glen, hemifontan)
  - Creation of superior cavopulmonary connection
  - Disconnect SVC from heart
  - Connect SVC to right pulmonary artery
  - Occlude RV-PA conduit

Pre-Stage 2 Catheterization

- Hemodynamics
  - Make sure that the pulmonary artery pressures and pulmonary vascular resistance (PVRi) are low
- Angiography
  - Make sure that there is only 1 SVC and that it is good-sized
  - Visualize the lung arteries to be sure there are no area of stenosis that need to be addressed at surgery

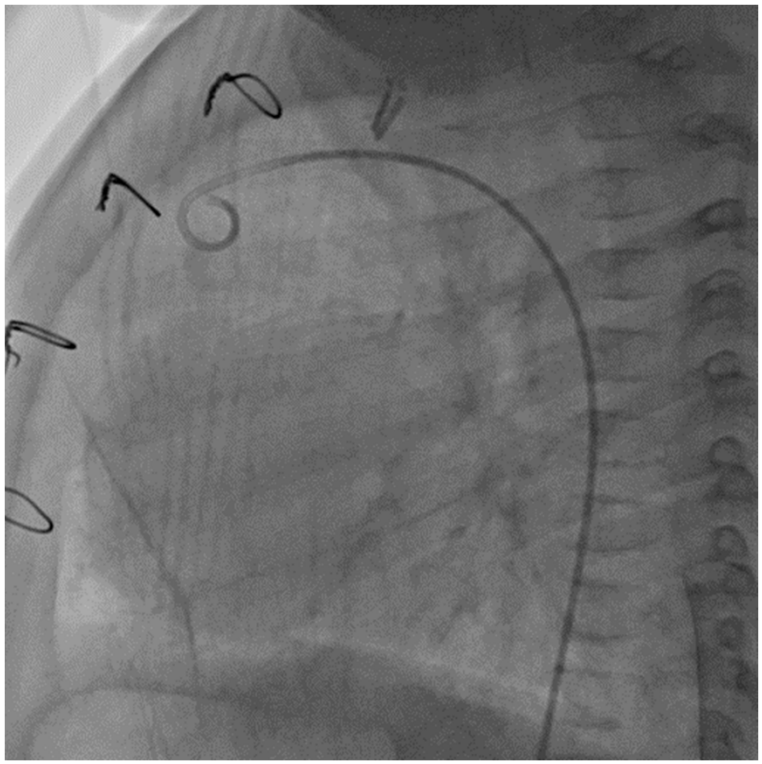
Pre-Stage 2 Catheterization



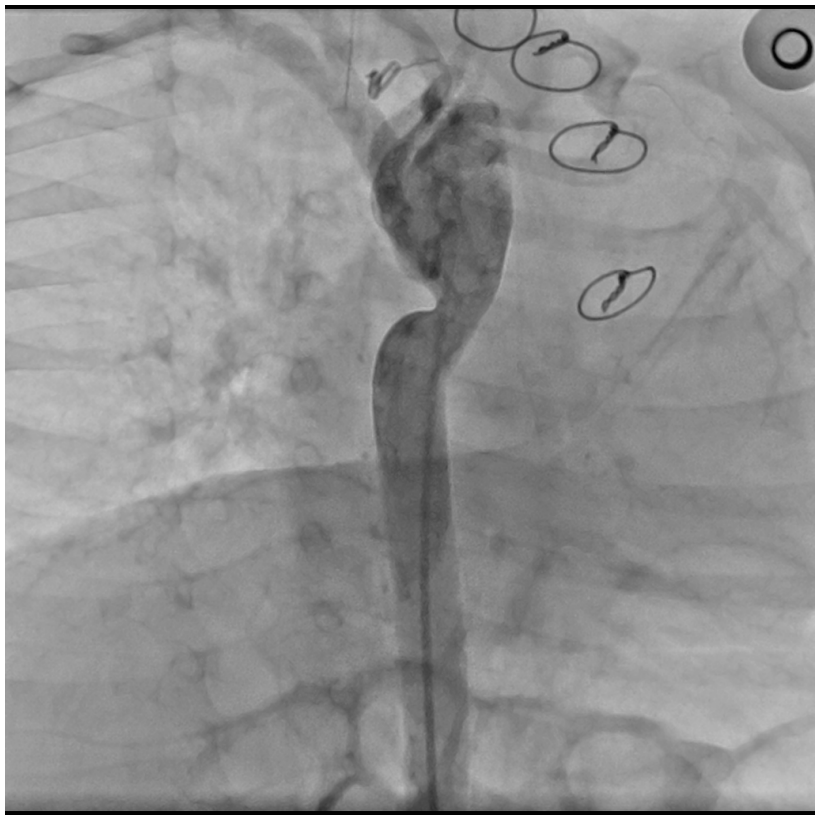
Baseline

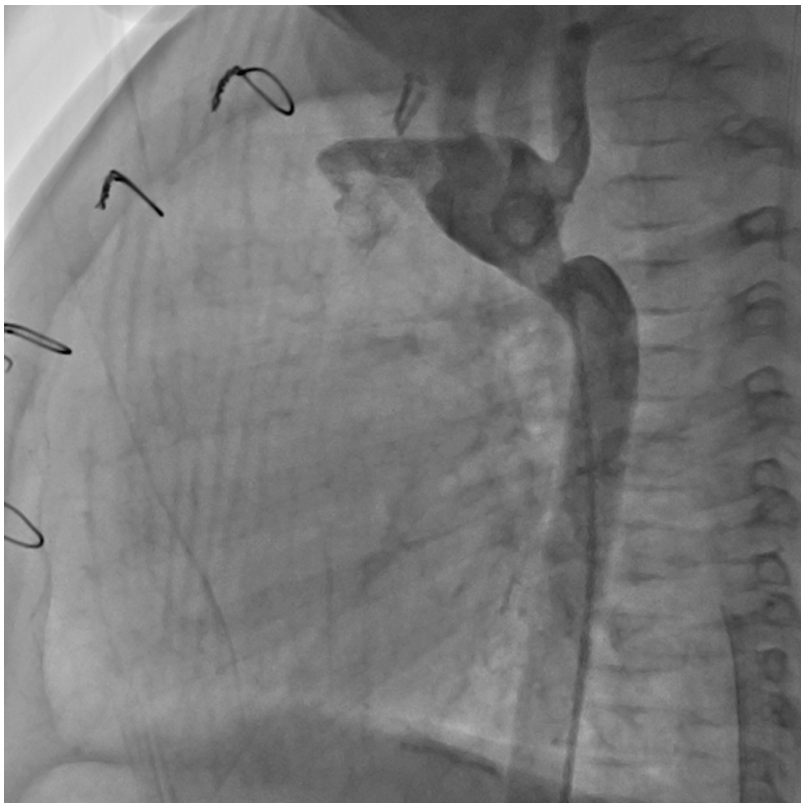
Qp = 1.32 L/min (4.41 L/min/m2)
Qs = 1.87 L/min (6.23 L/min/m2)
Rp = 4.53 units (1.36 units x m2)
Rs = 31.58 units (9.47 units x m2)
Qp/Qs = 0.71 : 1 | Rp/Rs = 0.14

Pre-Stage 2 Catheterization

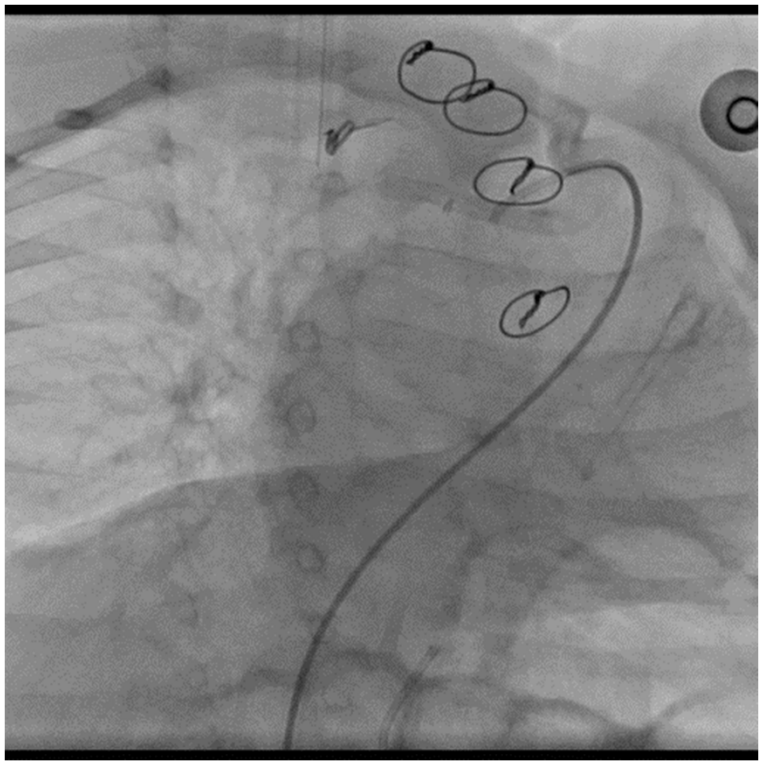


Pre-Stage 2 Catheterization

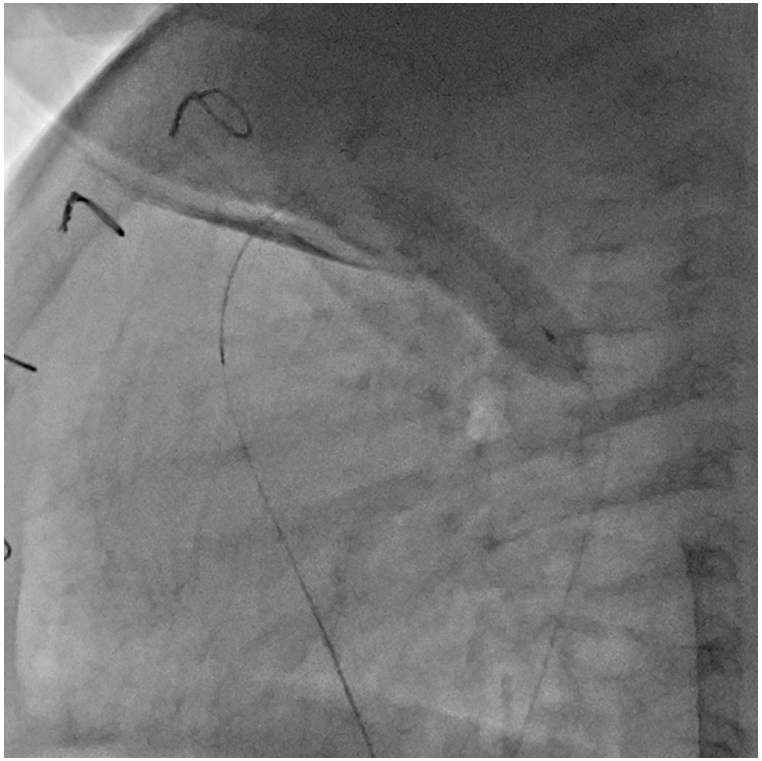


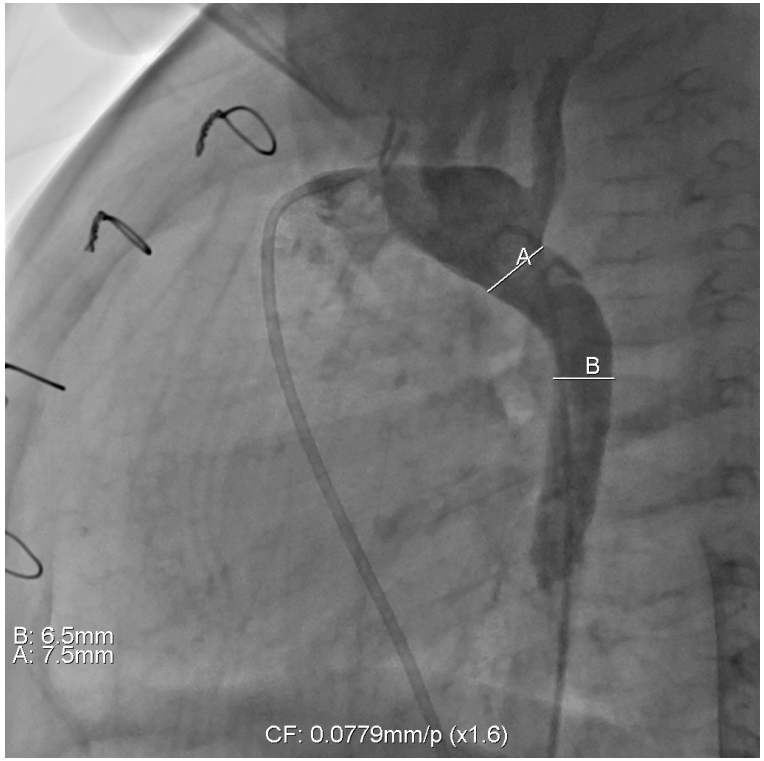


Pre-Stage 2 Catheterization

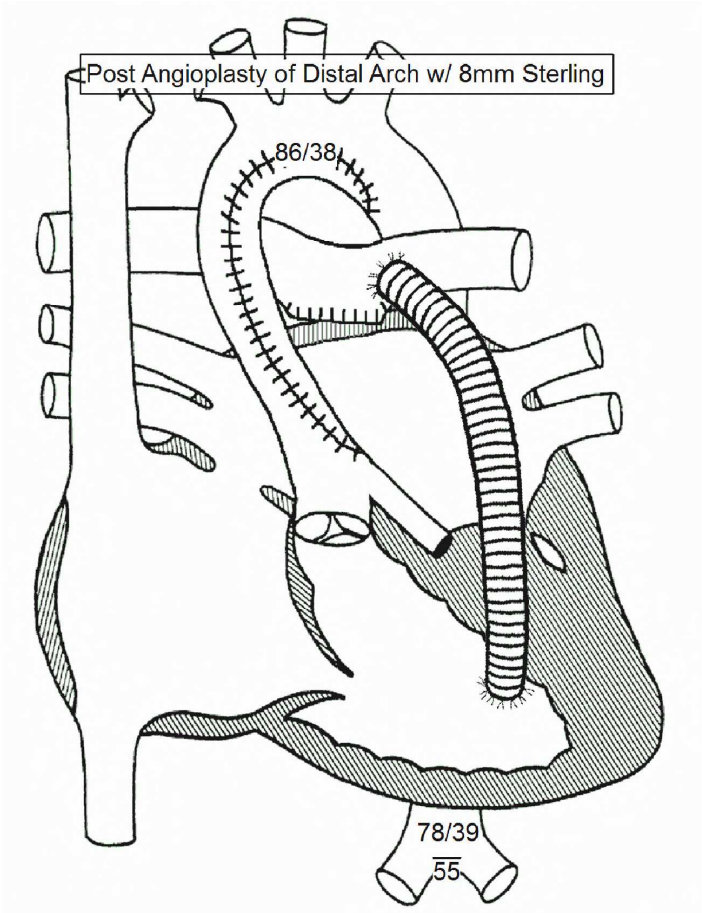


Pre-Stage 2 Catheterization





Pre-Stage 2 Catheterization



Pre Stage 2 Catheterization

- Low pulmonary artery pressures
- Large, unobstructed pulmonary arteries
- Normal sized superior vena cava
- Arch obstruction was successfully treated with angioplasty
- Reasonable candidate for Stage 2