Right Heart Catheterization
Shunt evaluation

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Data from Right Heart Cath

- Oximetry run
- Pressure data
  - CVP
  - RA
  - RV
  - PA
  - PCWP

A Complete Oximetry run

- Left and/or Right PA
- Main PA
- RVOT
- RV mid
- RV TV or apex
- RA low (near TV)
- RA mid
- RA high

- SVC low (near RA junction)
- SVC high (near inominate vein)
- IVC high (just below diaphragm)
- IVC low (at L4-L5)
- LV
- Ao

The "Community" Ox run

- PA
- IVC/RA
- FA
- LV/Ao

Significant Step Ups
% sat

- Mean of distal – mean of proximal
- SVC/IVC → RA >=7%
  - ASD; anomalous pulmonary vein, ruptured sinus of valsava, VSD with TR, coronary-RA fistula
- RA → RV >=5%
  - VSD; PDA with PR; primum ASD, coronary-RV fistula
- RV→ PA >=5%
  - PDA; aorto-pulmonary window, aberrent coronary origin
- Any step up SVC→PA >=7%

Mixed venous O_2 sat

- In calculations, depends on level of shunt
- RA shunt (ASD)
  - [3(SVC) + 1(IVC)] /4
- RV (VSD)
  - Average of all RA samples
- PA (PDA)
  - Average of all RV samples

Calculation of blood Flow

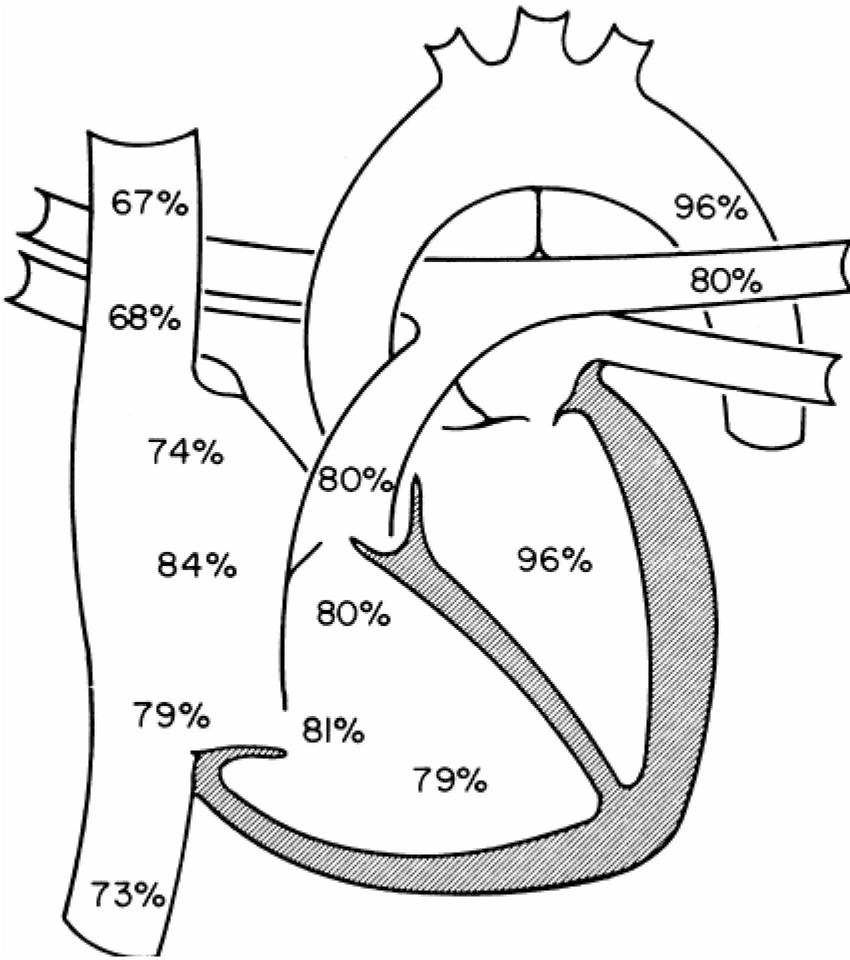
- Qp = O2 consumption /
PV O2 content – PA O2 content

- Qs = O2 consumption /
SA O2 content – MV O2 content

O2 consumption

- Douglas bag most accurate
  - Never used
- Estimated common (10% error)
  - 125 mL/m^2 (110 mL/m^2 for elderly)
  - BSA (m^2) = Sq Root (wt in kg * height in cm/3600)
- AV difference (Fick) (5% error)
  - Photodetector technique of expired air
  - Cardiac ouput = O2 consumption/A-V O2 oxygen content difference
    - Hgb x 1.36 x 10 x (Arterial O2 – Mixed Venous O2)

Example 1

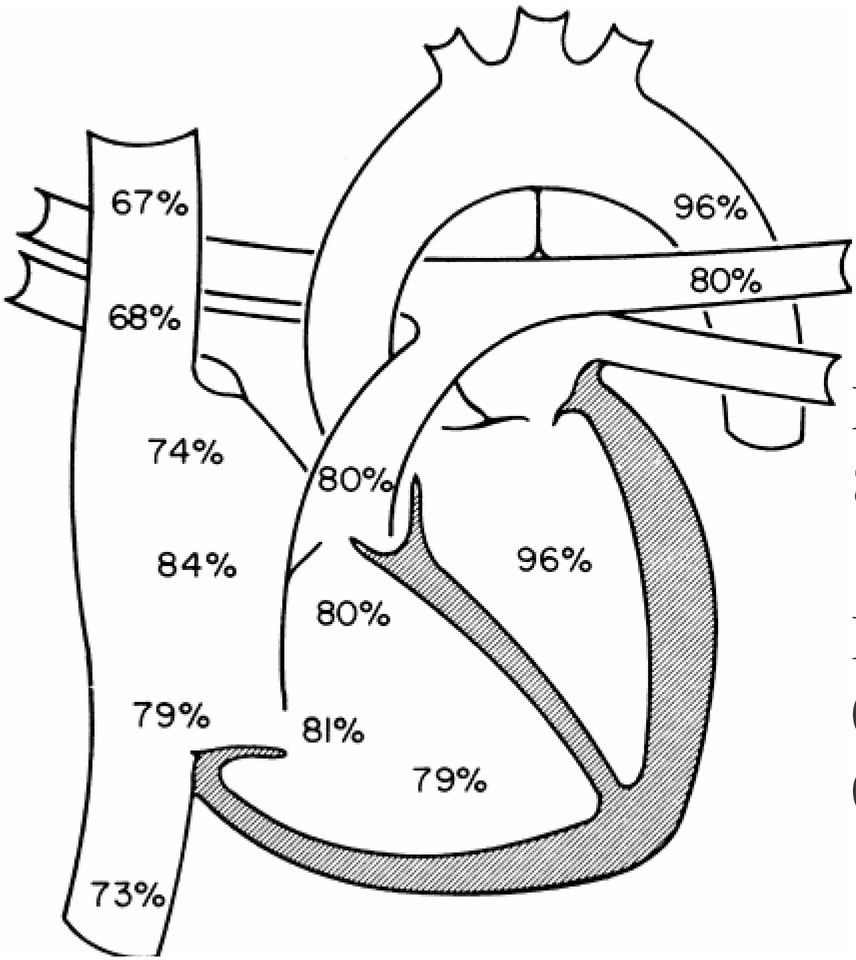


O2 consumption = 240 mL O2/min
Hgb = 14

PV O2 %?
96%
no R->L ventricular shunt as Ao and LV are same

PVO2 content =
0.96 * 14g/100mL * 1.36 mL O2/g
0.183 mL O2/ mL blood
183 mL O2/L

Example 1

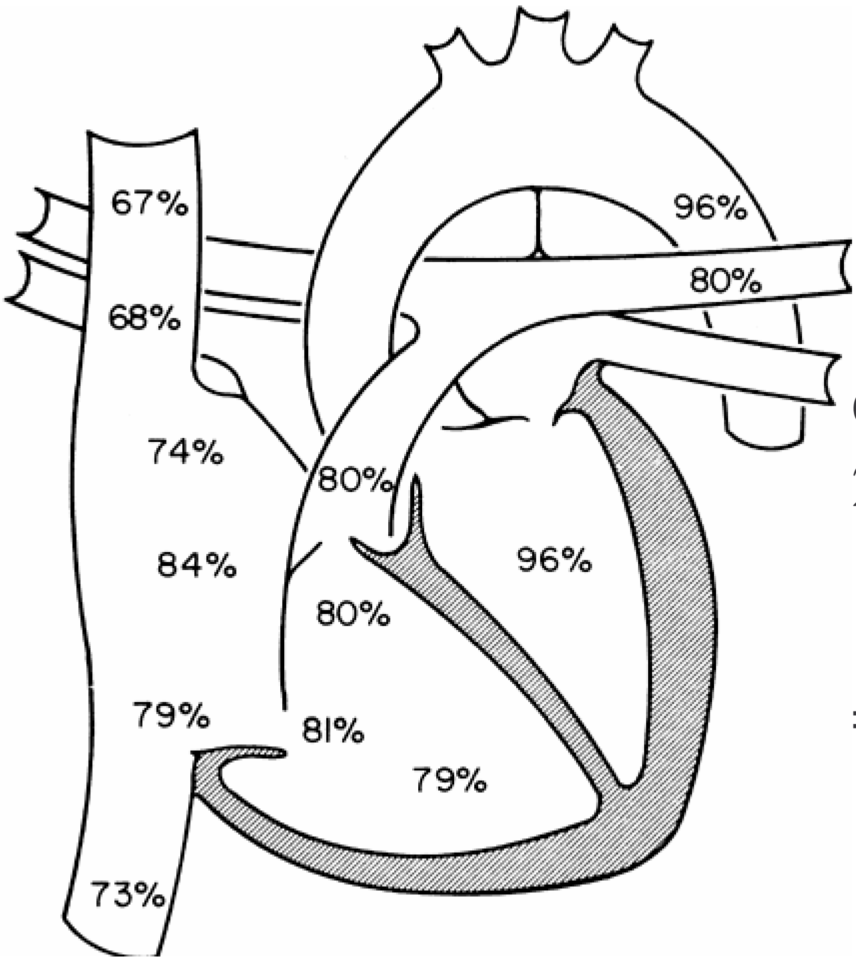


O2 consumption = 240 mL O2/min
Hgb = 14

PA O2 %?
80%

PAO2 content =
0.80 * 14g/100mL * 1.36 mL O2/g
0.152 mL O2/ mL blood
152 mL O2/L

Example 1

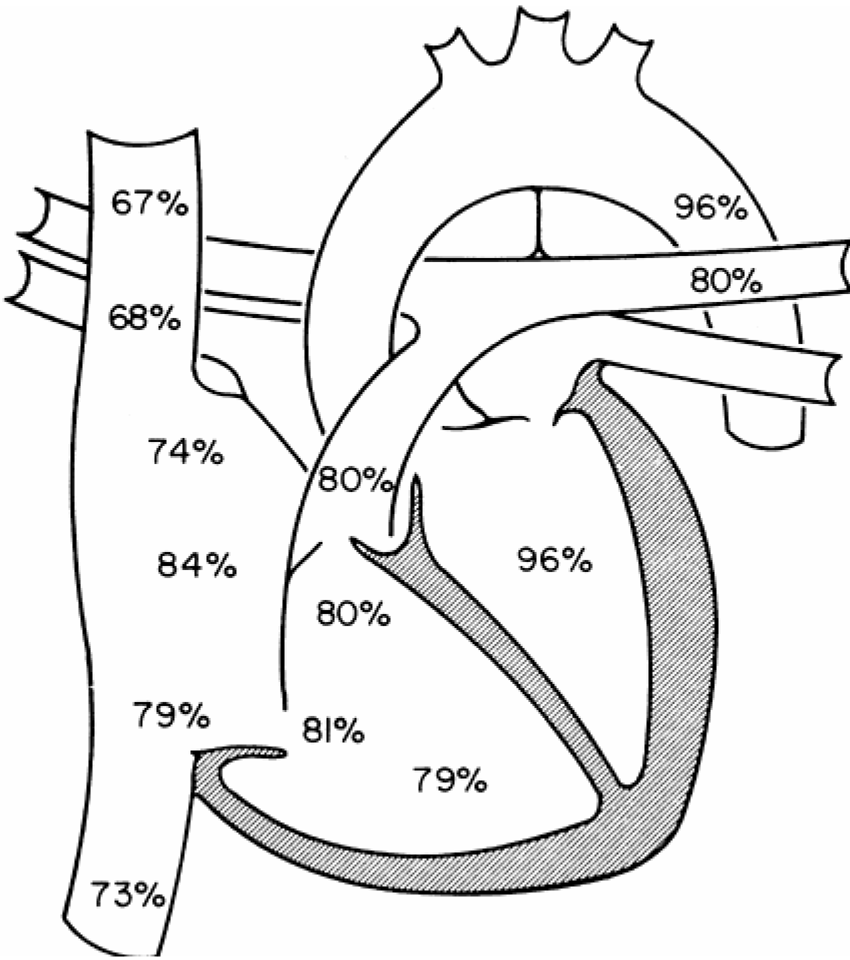


O2 consumption = 240 mL O2/min
Hgb = 14
PV O2 = 183 mL /L
PA O2 = 152 mL /L

Qp?
240 mL O2/min /
[183 – 152] mL/L

= 7.74 L/min

Example 1

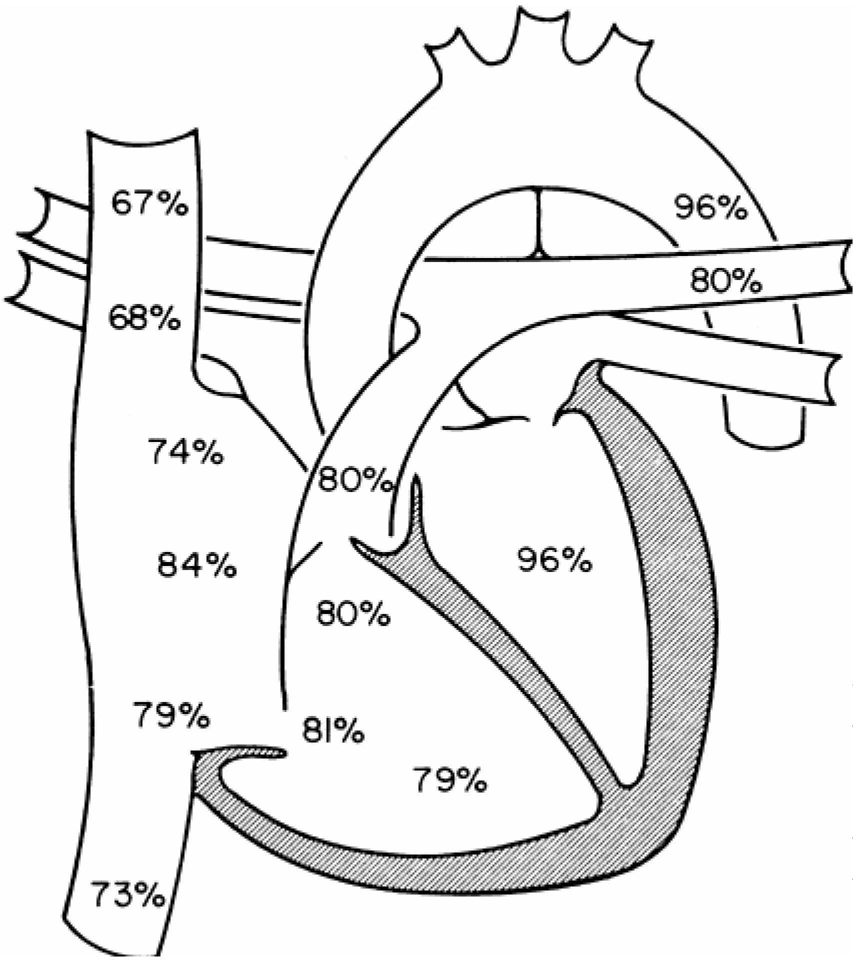


O2 consumption = 240 mL O2/min
Hgb = 14
PV O2 = 183 mL /L
PA O2 = 152 mL /L
Qp = 7.74 L/min

Qs?
SA O2?
0.96 * 14/100 * 1.36 = 183 mL/L

MV O2?
(3 * 67.5) + (73) / 4 = 69
0.69 * 14/100 * 1.36 = 131 mL/L
Qs = 240/(183 – 131) = 4.6 L/min

Example 1

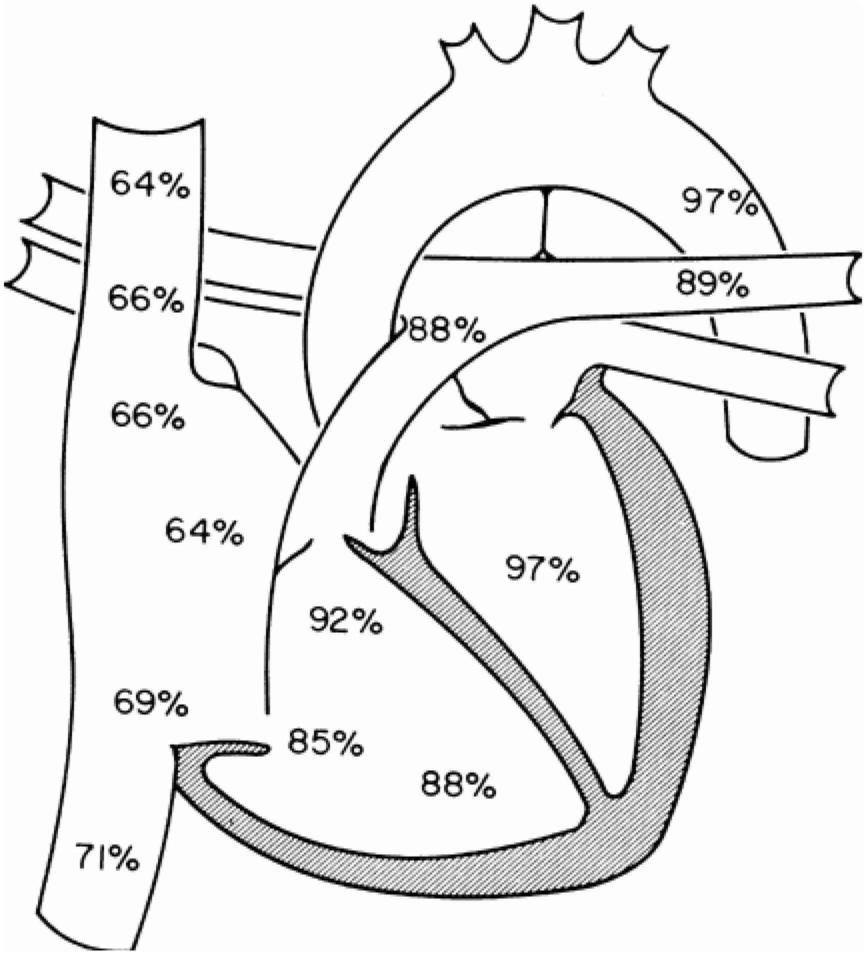


O2 consumption = 240 mL O2/min
Hgb = 14
PV O2 = 183 mL /L
PA O2 = 152 mL /L
Qp = 7.74 L/min
Qs = 4.6 L/min

Qp/Qs?
7.74/4.6 = 1.68
Magnitude of shunt = 3L/min

L→R ASD

Example 2



O2 consumption = 260 mL O2/min
Hgb = 15

Qp?
PV = 97%
PA = 88.5%
260 / [(97 – 88.5) * 15 * 1.36 * 10]
Qp = 15 L/min

Qs?
SA = 97%
MV = (66 + 64 + 69)/3 = 66%
260 / [(97 – 66) * 15 * 1.36 * 10]
Qs = 4.1 L/min

Qp/Qs = 15/4.1 = 3.7 VSD (L→R)

Simplfied

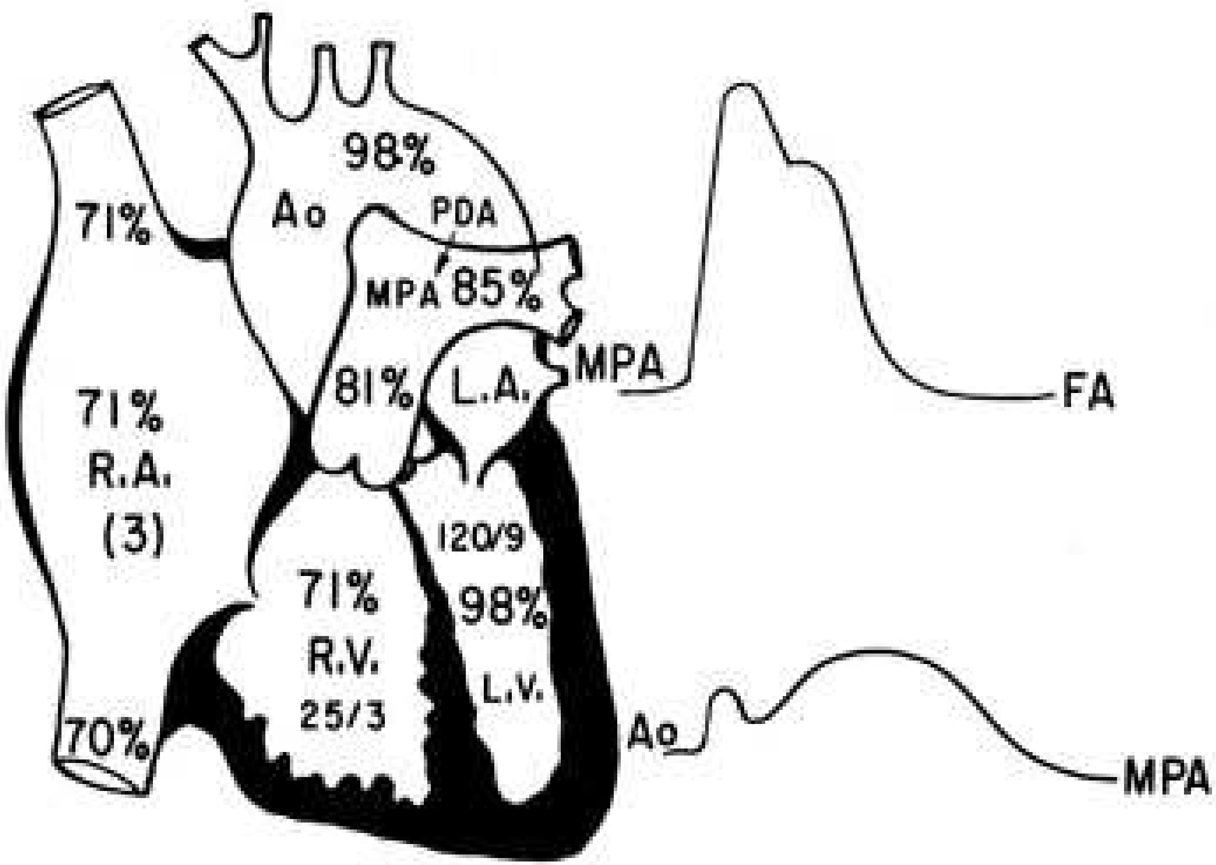
- Qp = O2 consumption / PV O2 content – PA O2 content
- Qs = O2 consumption / SA O2 content – MV O2 content

- Qp/Qs = (SA – MV) / (PV – PA)

Bidirectional shunt

- Hypothetical Q effective
  - $Q_{eff} = O_2 \text{ consumption} / (PV\ O_2 - MV\ O_2)$
- L→R shunt = Qp – Qeff
- R→L shunt = Qs - Qeff

Example 3



Qp/Qs?

[98 – 71] / [85-81]
6.75

Where is the shunt?
PDA

http://www.redtail.net/owc/8.html

Example 4

- Hgb 13
- O2 consumption 210 mL/min
- FA 92%
- PV 95%
- PA 83%
- Low RA 68%
- Mid RA 85%
- SVC 70%
- IVC 68%

Qp?
210/(95-83)*1.36*13*10
10 L/min

Qs?
210/(92-70)*1.36*13*10
5.1 L/min

Qp/Qs?
1.96

Type of Shunt?
ASD, L→R

Example 4

- Hgb 13
- O2 consumption 210 mL/min
- FA 92%
- PV 95%
- PA 83%
- Low RA 68%
- Mid RA 85%
- SVC 70%
- IVC 68%

What if shunt is biderectional?

Qeff = O2 cons / PV - MV
210/(95-70) * 1.36*13*10
Qeff = 4.75 L/min

Qp = 10 L/min
Qs = 5.1 L/min

L→R = Qp-Qeff
10-4.75 = 5.25
R→L = Qs-Qeff
5.1-4.75 = 0.35

Example 5

- Hgb = 15
- O2 consumption = 195 mL/min
- FA 89%
- LA 88%
- PV 96%
- PA 82%
- Low RA 82%
- Mid RA 83%
- SVC 81%
- IVC 70%

Where is the step up?
IVC→RA

What about a step down?
PV→LA

What is this?

- –ASD
- –anomalous pulmonary vein
- –ruptured sinus of valsava
- –VSD with TR
- –coronary-RA fistula

Example 5

- Hgb = 15
- O2 consumption = 195 mL/min
- FA 89%
- LA 88%
- PV 96%
- PA 82%
- Low RA 82%
- Mid RA 83%
- SVC 81%
- IVC 70%

Calculate for biderectional shunt

Qeff = O2 cons / PV - MV

Qeff = 195/(96-[70+3*81]/4) * 1.36 * 15 * 10

Qeff = 5.4 L/min

Qp = 195/(96-82) * 1.36 * 15 *10

Qp = 6.8 L/min

Qs = 195/(89-78) * 1.36 * 15 * 10

Qs = 10.6 L/min

L→R = 6.8 – 5.4 = 1.4 L/min

R→L = 10.6 – 5.4 = 5.2 L/min