From Prenatal Dependency to Independence:
The wonders of circulatory transition from fetal to neonatal life

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”The Transition”

A lot can happen in a few minutes

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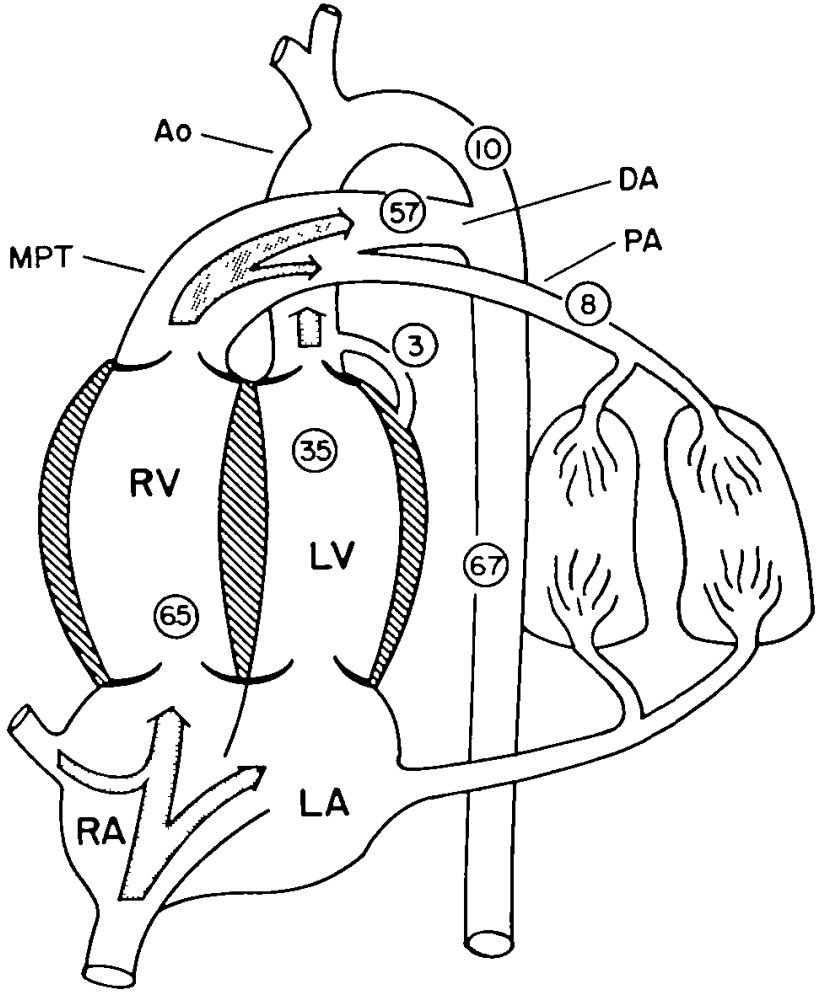
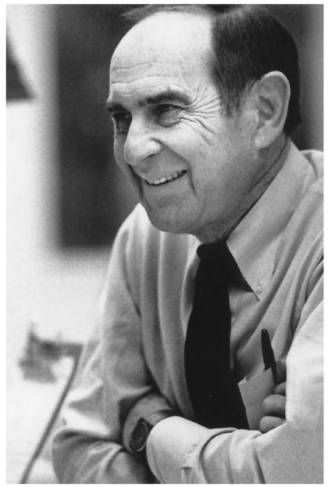
Guiding Principles



Fetal Lamb Model



Dr. Abraham Rudolph

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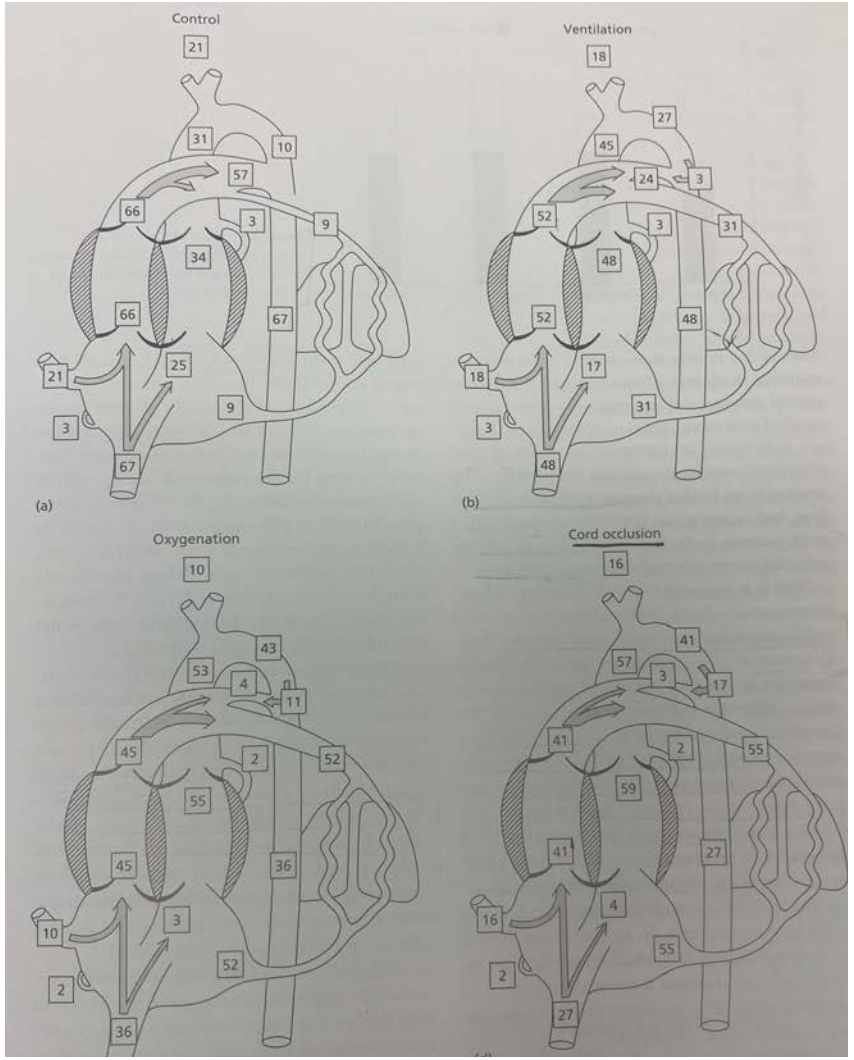
The Transition:
Learning from Animal Models

Circulatory Adjustments during Perinatal Transition:

"In parallel" circulation → "in series" circulation



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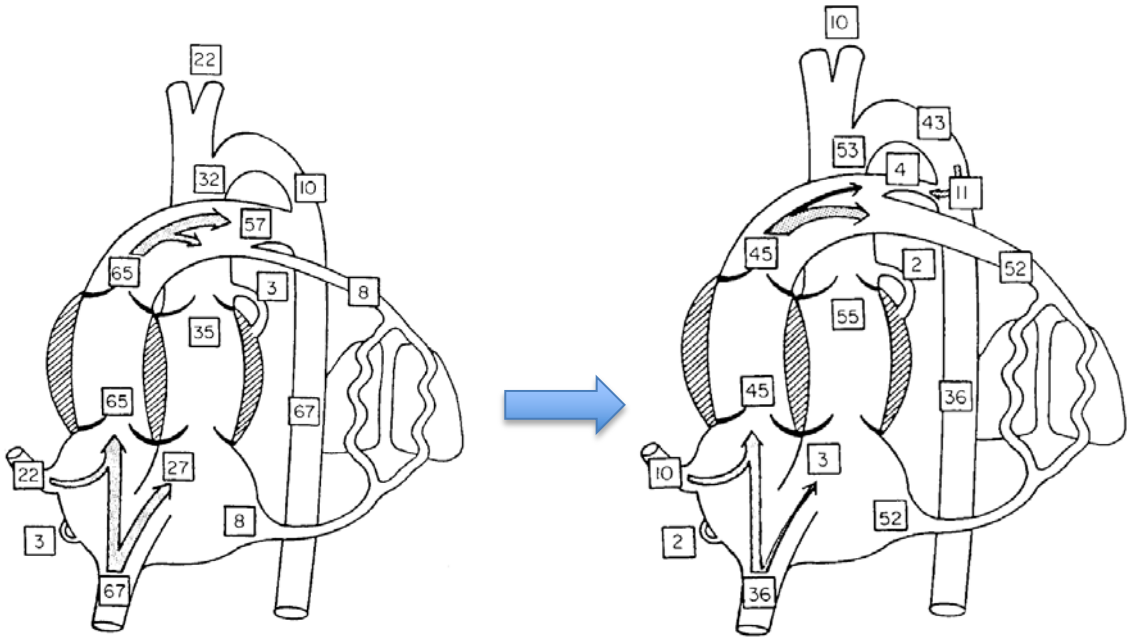
Rudolph AM

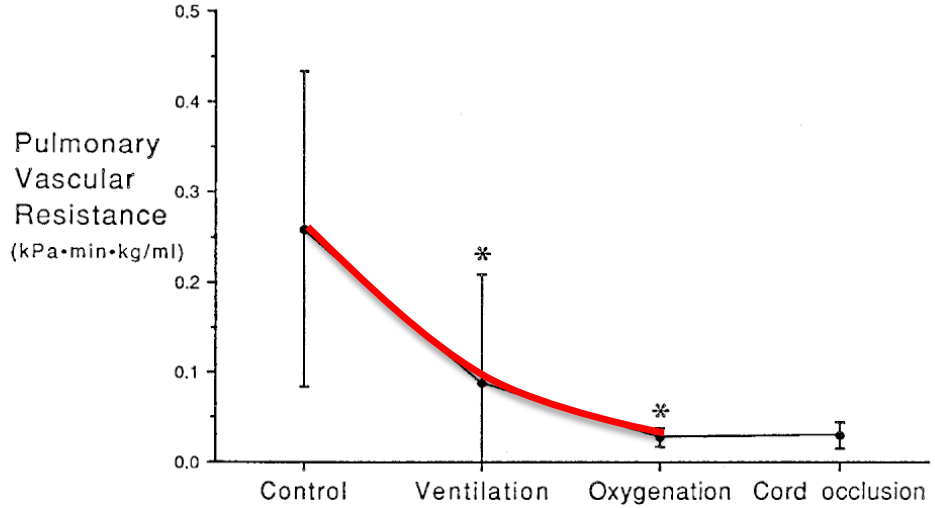
Perinatal Circulatory Changes

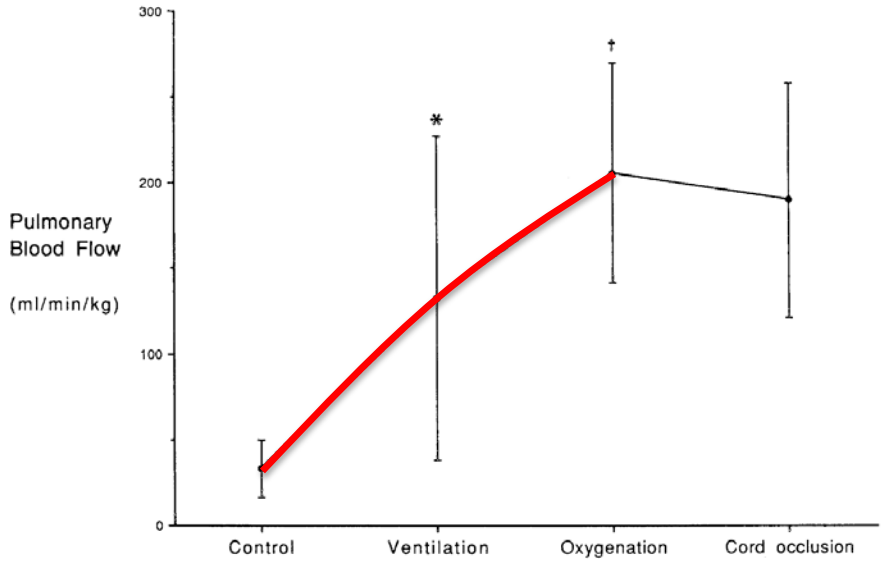


Baseline

Ventilation + Oxygenation

⇓Pulmonary vascular resistance
⇑Pulmonary blood flow





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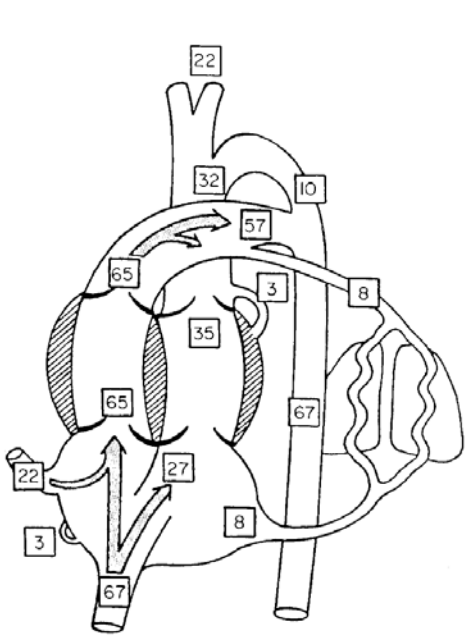
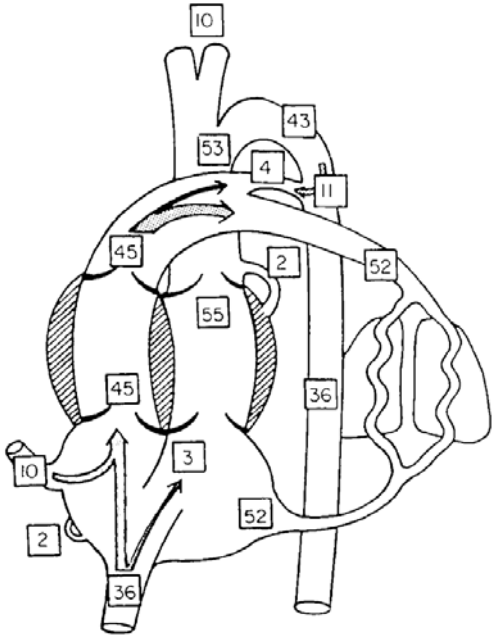
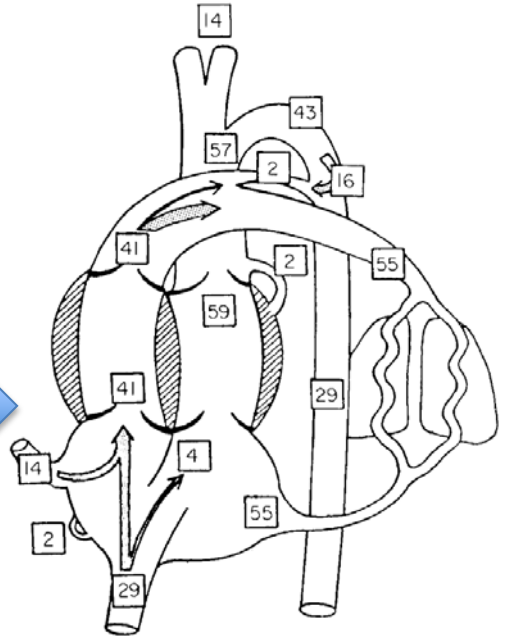
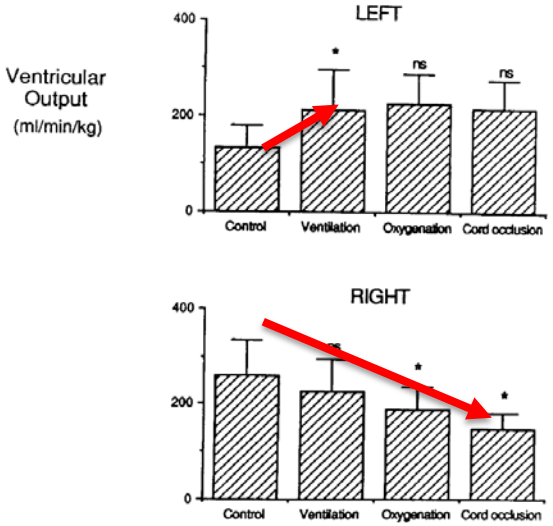
Teitel DF, Rudolph AM, 1986

Perinatal Circulatory Changes









Baseline

Ventilation + Oxygenation

Umbilical Cord Occlusion

↑ LV output
↓ RV output
↑ SVR

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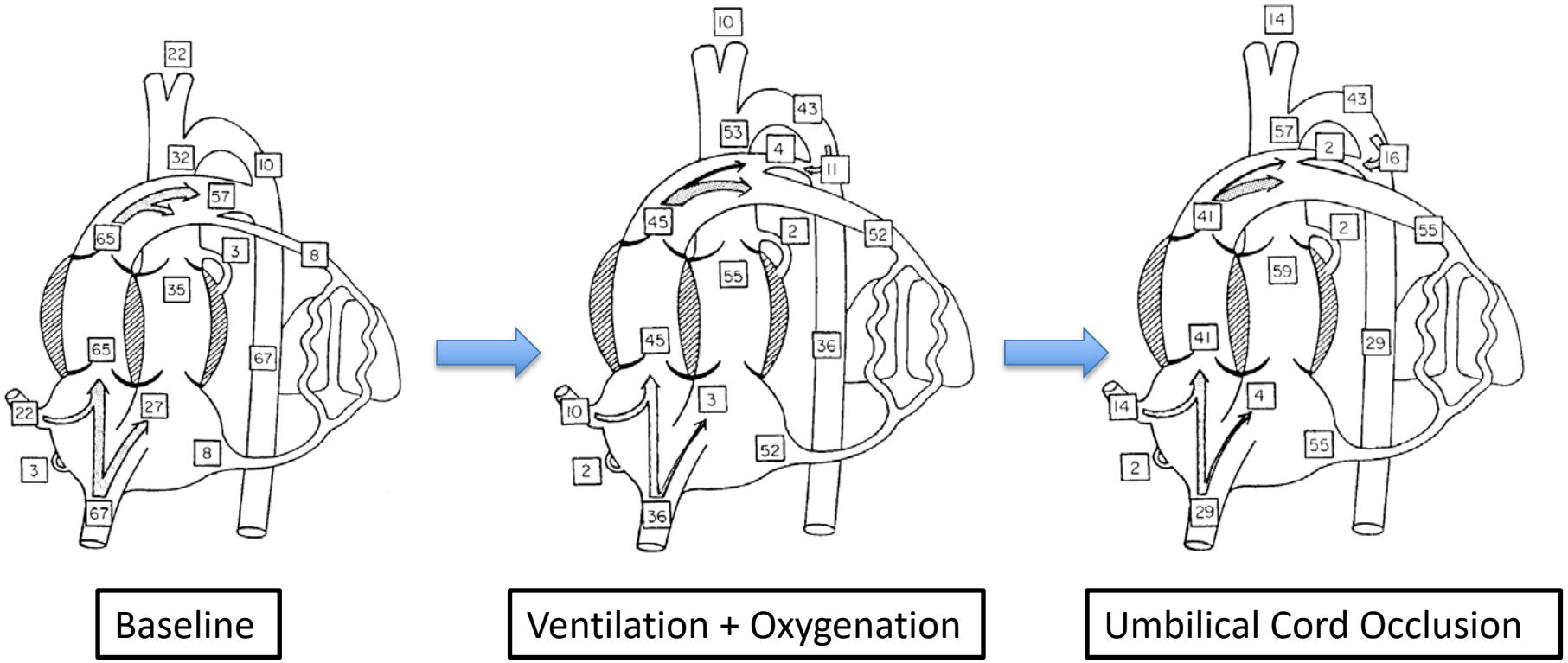
Teitel DF, Rudolph AM, 1991

Perinatal Circulatory Changes



Baseline

Ventilation + Oxygenation

Umbilical Cord Occlusion

Additional Factors:

1) Hormonal
   - Thyroid
   - Cortisol
2) Tissue Oxygen Delivery:
   - High HbF → HbA
   - Decreased Hb concentration

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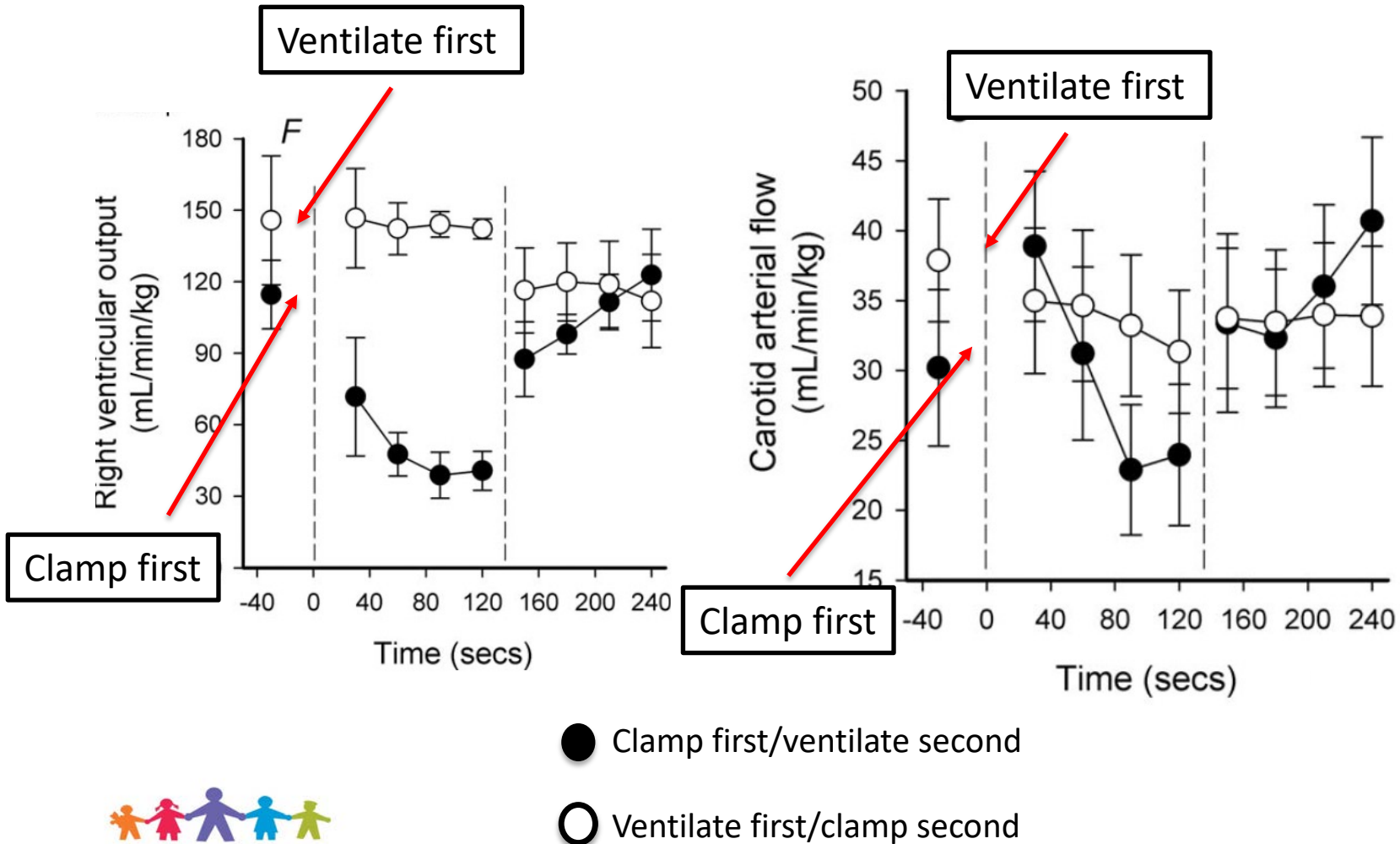
Teitel DF, Rudolph AM, 1991

Manipulating Physiology in Animal Models



- Clamping of umbilical cord prior to ventilation:
  - Decreased RV output
  - Decreased carotid arterial flow

● Clamp first/ventilate second

○ Ventilate first/clamp second

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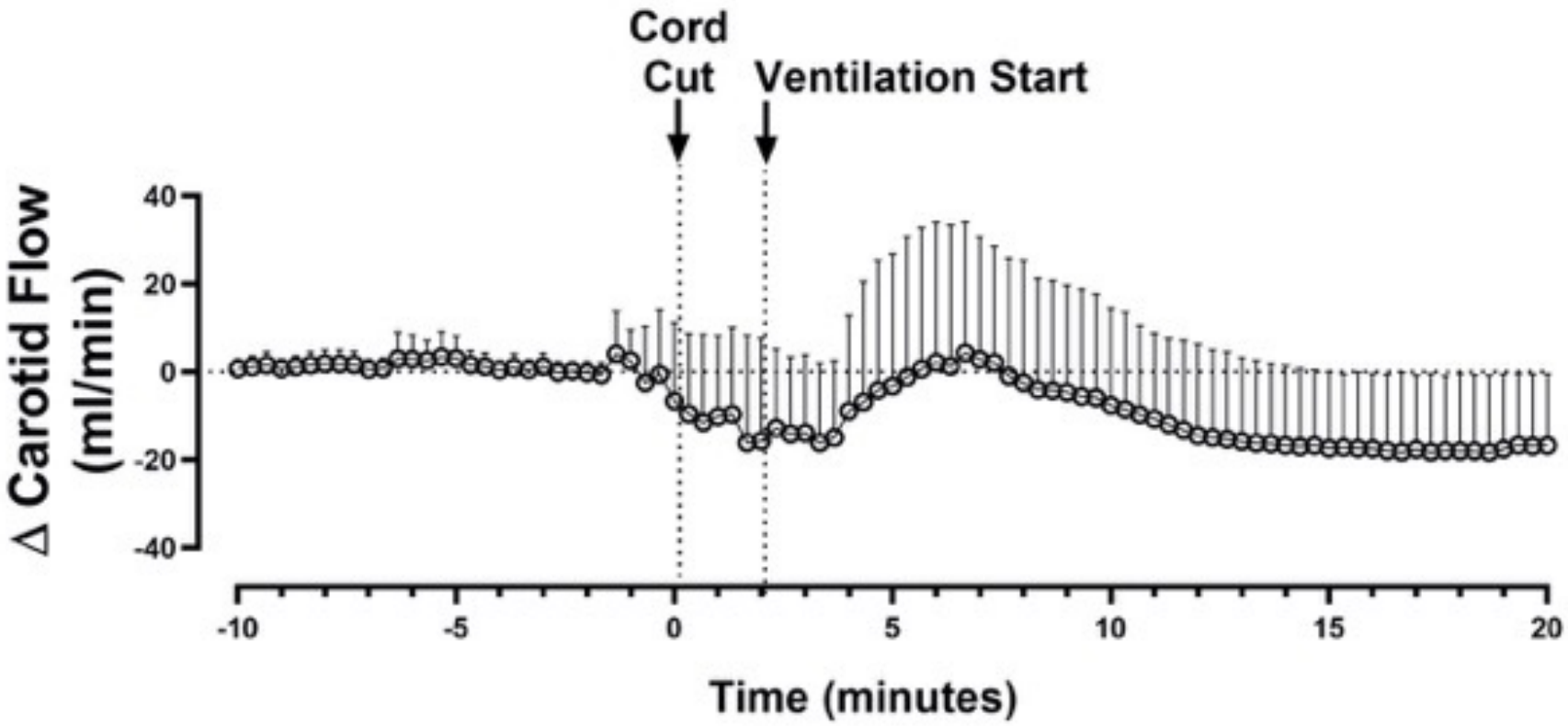
Bhatt L et al, 2013

Manipulating Physiology in Animal Models



Sequence of events in the DR influences the circulatory changes during transition

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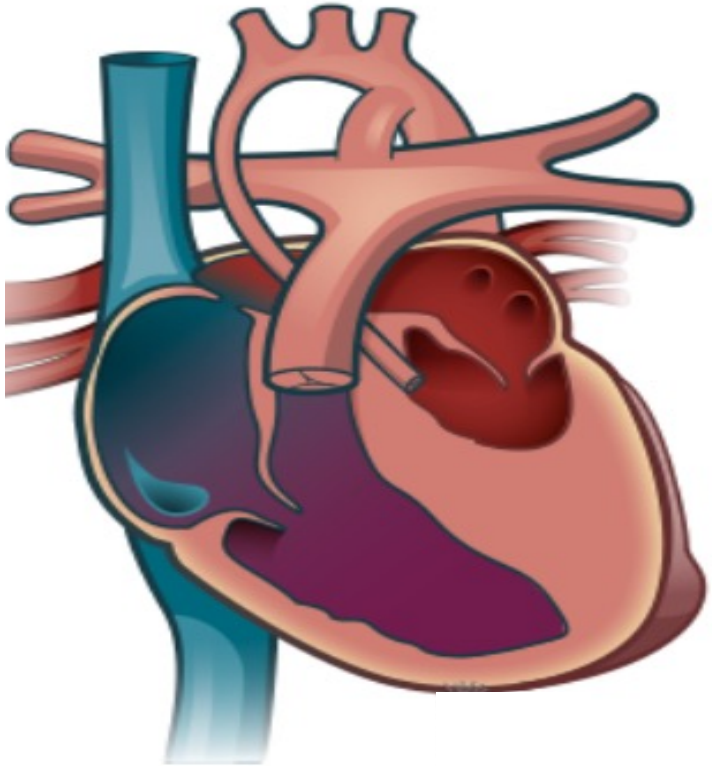
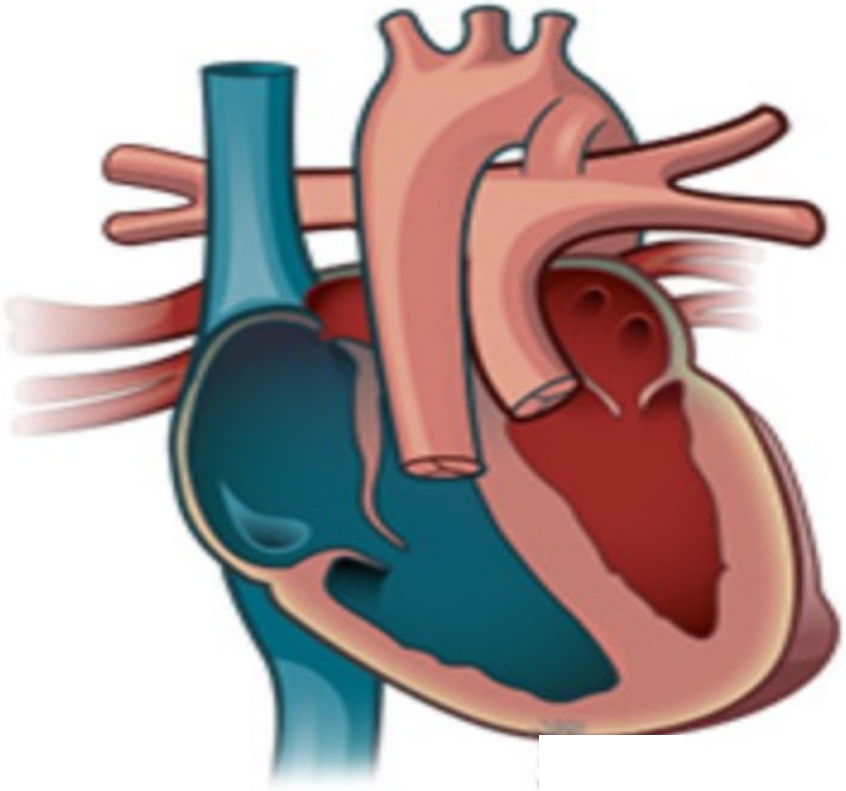
Janna Morrison PhD, University of Adelaide

How is this applicable to CHD?



HLHS



D-TGA

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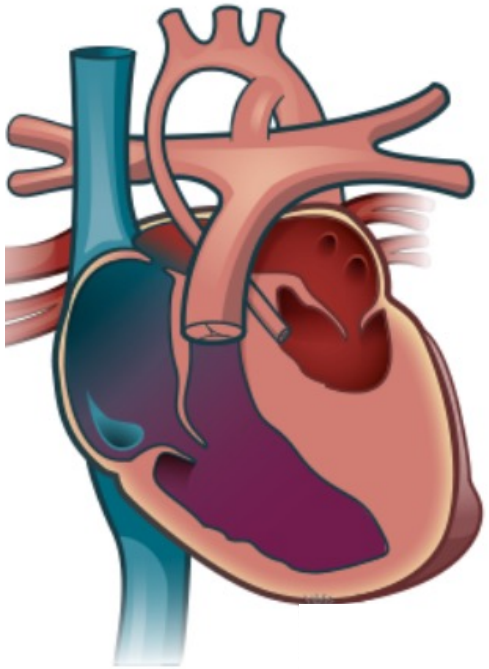
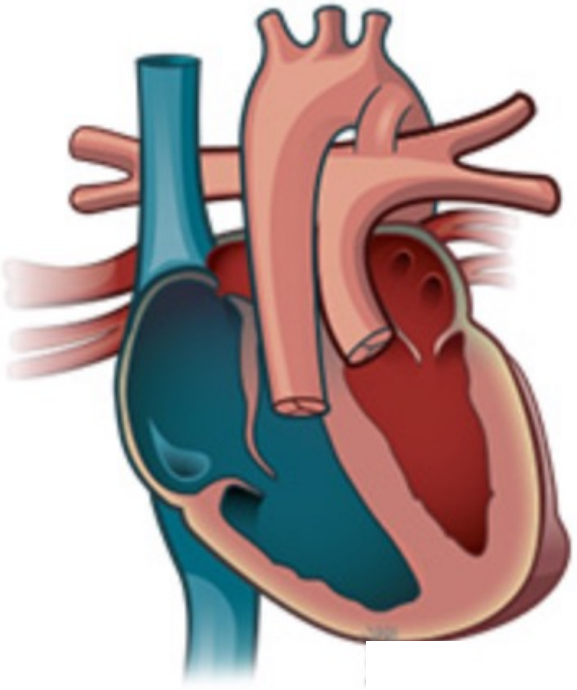
How is this applicable to CHD?
Circulatory Adjustments in the DR

- Increased pulmonary blood flow
- Changes in ventricular output
  - Decreased RV output
  - ? Effects on cerebral blood flow

- Sequence of events in the delivery room may have significant implications in the setting of CHD:
  - Timing of umbilical cord occlusion



HLHS



D-TGA

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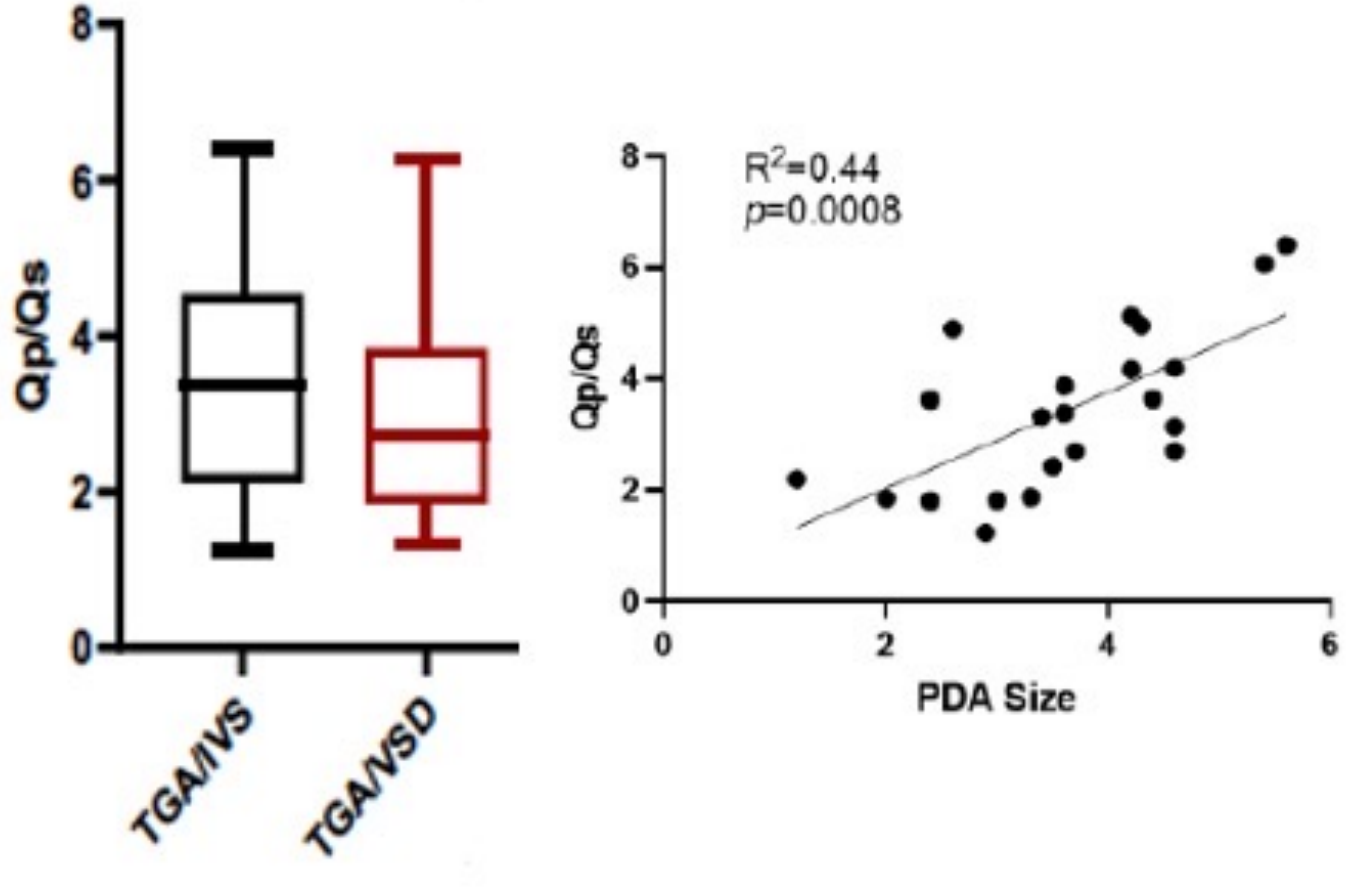
Transition from Fetus --> Neonate: Circulatory Adjustments outside of DR



- **Continued decline in PVR (higher Qp:Qs)**

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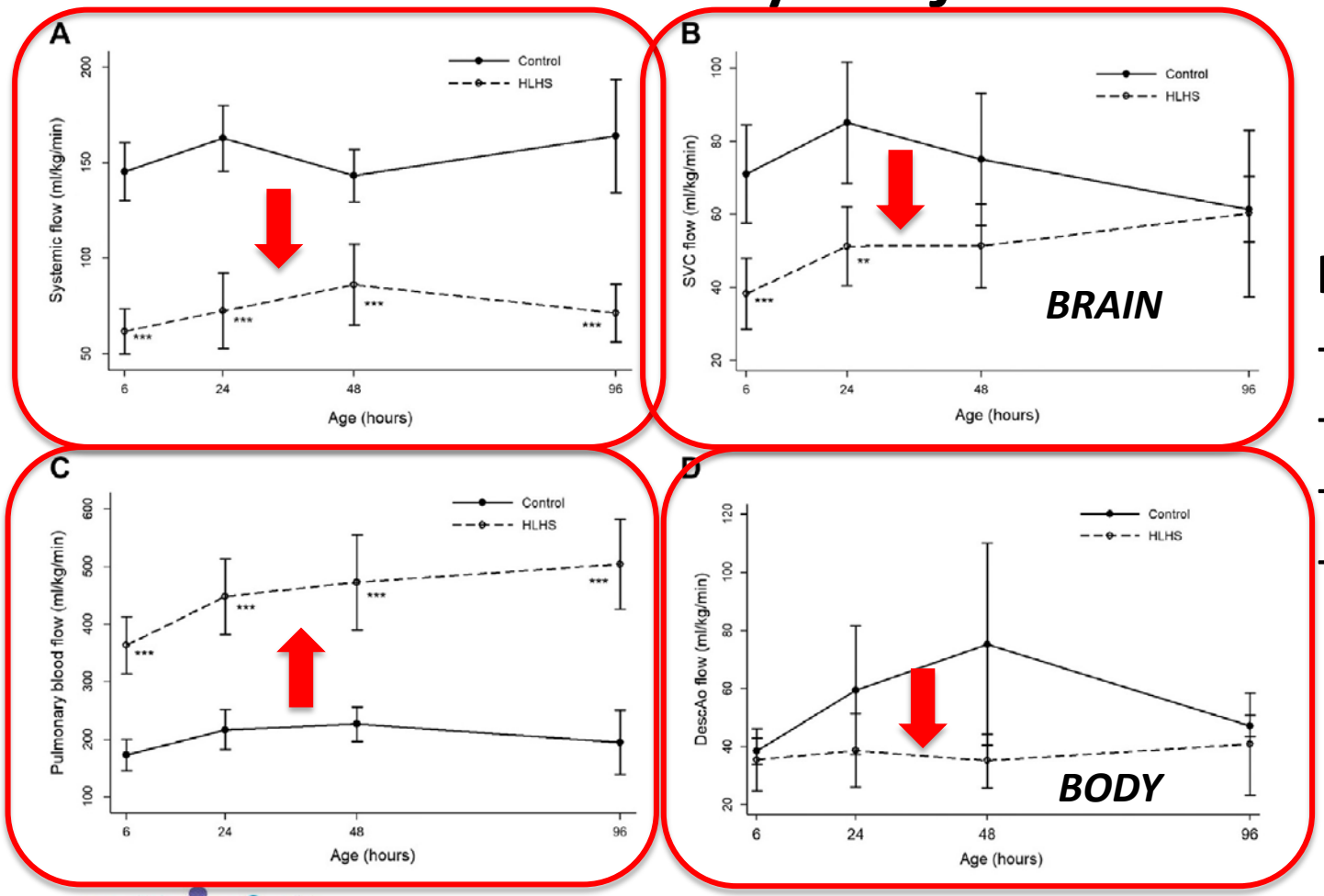
Seed M et al, Preliminary Data

Transition from Fetus --> Neonate: Circulatory Adjustments outside of DR



HLHS compared to healthy newborns:

- Decreased systemic flow
- Increased pulmonary blood flow
- Decreased flow in SVC (cerebral flow)
- Decreased lower body perfusion

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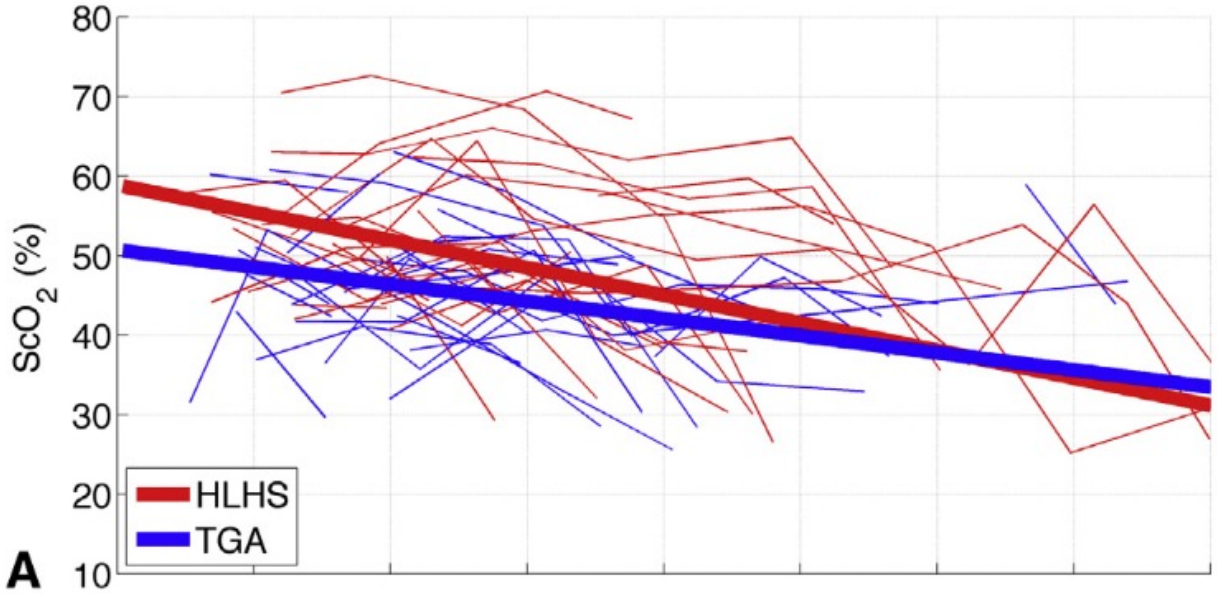
Eckersley L et al, 2021 CJC

Transition from Fetus --> Neonate: Circulatory Adjustments outside of DR



Lynch J et al, 2018

- Gradual decline in cerebral oxygenation from birth to surgery in d-TGA and HLHS

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Application of experimental data: Brain health in CHD

- *1/3 of newborns with complex CHD have evidence of white matter injury before going to the operating room*

- Immediate effects in the DR + continued postnatal effects
  - Threaten cerebral perfusion
  - Impairs cerebral oxygen delivery
  - Contribute to risk of pre-operative WMI and ND outcomes?

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”The Transition”

Early opportunities to optimize outcomes

- *Events in the Delivery room*
- *Continued circulatory changes outside of delivery room*

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Thank you

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