Maternal and Neonatal Outcomes Following a Fontan Procedure: A 10-year retrospective study

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Background

- Single-ventricle physiology
- Surgical palliation: vascular shunts to pulmonary artery
  - Blalock-Taussig shunt, Fontan procedure
  - The Fontan procedure is considered definitive repair.
    - Deoxygenated systemic venous flow → pulmonary arterial circulation w/o intervening pump
    - Sequelae: chronically elevated SVP, decrease CO and decreased cardiac reserve

Pregnancy changes in blood volume and hemodynamics

Background

- Challenge of Fontan circulation in the setting of pregnancy.
  - Obligatory increase in HR, CO and plasma volume.
  - During L&D: increases in CVP and CO, affect of anesthesia, fluid shifts, concern for arrhythmia.
  - Fetal oxygenation.

**Objective / Hypothesis**

- **Objective**: To determine a relationship between maternal cardiac function through gestation and a SGA neonate.

- **Hypothesis**:
  - ↓ CO in early pregnancy linked to ↓ fetal growth  
  - ↑ preterm delivery
Methods

- Single-center (University of California, Los Angeles) retrospective cohort study.
- Deliveries of women with Fontan circulation between 2006 – 2016 were included.
- All pregnancies >24 0/7 weeks were evaluated for differences in maternal and neonatal characteristic and outcomes.
- Echocardiograms were reviewed from pre-pregnancy (>1 year before pregnancy) up to 10-years post-partum.
  - EF estimated using Simpson’s method of disk. dP/dT and RIMP/Tei index was also calculated.
- Statistical analysis: Student t-test and chi-squared used to compare categorical variables/means. Inter-correlation was investigated by Spearman rank correlation. Significance was set at a p-value<0.05.
Demographics

- 23 women involving 26 pregnancies.
- Mean age at pregnancy was 25.1 ± 4.1 years.
- Mean BMI was 26.4 ±2.8 kg/m².
- Women were racially and ethnically diverse.
Maternal Complications and Obstetrical Management

- Sustained arrhythmia (36%)
- Decompensated heart failure (21%)
- No maternal deaths
- Vaginal delivery 46% (58% operative VD)
- Regional anesthesia 95%
Neonatal Outcomes

- Fetal demise 2/26 (7.7%) – 30 and 37 4/7 weeks
- Preterm delivery (<37 weeks) 50%
- Gestational age 34 5/7 ± 4 5/7 weeks
- Birth weight 2.29 ± 0.55 kg
- 29% Neonatal ICU admissions
EF through gestation

- EF declined from pre-pregnancy to the first-trimester (p<0.05).
- EF returned to pre-pregnancy levels within 1-5 yrs post-partum.
Ventricular Contractility (dP/dT)

\[ y = -1.0684x + 882.34 \]

\[ R^2 = 0.0003 \]
Myocardial Performance Index: RIMP / Tei index

$y = -0.0094x + 0.5721$

$R^2 = 0.1855$
Single ventricle physiology predisposes premature SGA neonate

- 77% of the neonates were SGA at delivery (<10th %ile).

- Odds ratio (OR) of SGA neonate:
  - OR 10.1, 95% CI (2.9 – 48)
  - aOR 11.7 (95% CI 2.1 – 72)
First trimester EF changes is associated with a SGA neonate

- Reduced 1st trimester EF correlated with a SGA neonate (Spearman rank correlation \(r=0.60, p<0.05\)) adjusted for gestational age.

- Sensitivity: 88.2%, Specificity 22.2%
Conclusions

- Pregnancies with single ventricle physiology is associated with increased adverse maternal and neonatal outcomes.

- Women with a Fontan procedure have a significant decline in EF during the first trimester.

- Decreased first trimester EF predicts SGA neonate.

- Further research is needed to determine components and timing of cardiac reserve and neonatal outcome. Epigenetics?
Acknowledgments

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Francis Fontan
1929 - 2018