Fetal Hypoxemia Causes Abnormal Myocardial Development In A Preterm *Ex Utero* Fetal Ovine Model: Implications For Adult Cardiovascular Disease and Novel Fetal Therapy

Carlo Bartoli, MD, PhD

Department of Surgery, Division of Cardiovascular Surgery
University of Pennsylvania, Perelman School of Medicine
Philadelphia, PA
Fetal Hypoxia and Severe Prematurity

- Fetal hypoxia is a leading cause of extreme prematurity
- Fetal viability of 22 to 23 weeks is possible

- Chronic lung disease
- Immature end-organ development
- Delayed neurocognitive development
- **Overall poor prognosis**
**Ex Utero Fetal Support System**

- Novel rescue therapy

- Supported *ex utero* for up to 28 days
  - Stable hemodynamics
  - Normal blood gas
  - Somatic growth

- Long-term survival with normal postnatal function

---

Project Goal

Fetal hypoxemia causes abnormal myocardial development in a preterm ex utero fetal ovine model

Hypothesis

Hypoxemic mechanical circulatory support of the fetus impairs myocardial development, whereas normoxic support allows normal myocardial development.
In Utero Gestation
- n=8

Normal Oxygen Delivery
- 24±2 days in biobag
- n=9

Chronic Hypoxemia
- 22±1 days in biobag
- n=7

Oxygen Delivery

Hypoxic but not normoxic animals developed anaerobic metabolism.

Myocardial Histology

Hypoxic fetuses exhibited abnormal myocardial architecture.

**Normoxic fetuses demonstrated similar architecture to controls.**

Conclusions

1. *Ex utero* fetal support under normoxic conditions resulted in normal myocardial architecture.

2. Fetal hypoxemia altered myocardial architecture.

Clinical Translation

1. These data will inform the nascent field of fetal mechanical circulatory support.

2. Additional studies will help to define the role for an artificial placenta as a rescue therapy for intrauterine pathology.

3. In hypoxic fetuses, myocardial histologic changes in the fetal period that persist into adulthood may contribute to adult heart disease.
Samson Hennessy-Strahs, BA
Maryann Villeda
Esha Bansal
Michael Acker, MD

Kendall Lawrence, MD
Patrick McGovern, MD
Ali Mejaddam, MD
Avery Rossidis, MD
Heron Baumgarten, MD
Marcus Davey, PhD
Alan Flake, MD

J William Gaynor, MD
Jack Rychik, MD

Other Contributors
Robert Dowling, MD, PhD (hon)