(A Brief) History of ECMO and ELSO

Steven Conrad, MD PhD
Director, ECLS Program
LSU Health - Shreveport
Acknowledgements

- Robert Bartlett, MD provided the historical photographs
Early extracorporeal circulation

- Reached clinical application in the mid to late 1950’s
- Use limited in duration by activation of blood components
- Largely attributed to early oxygenators with direct air-blood interface
- Duration of use limited to a few hours (cardiac surgical procedures)
Philip A. Drinker, PhD

Courtesy of Robert Bartlett, MD
Heparin titration and ACT measurement

Drinker and Bartlett, 1968
Silicone membrane lung

- Dimethylpolysiloxane (DMPS, silicone)
- Discovered in 1957
- By 1963 used in the construction of oxygenators suitable for long-term support
- Paved the way for long-term extracorporeal circulation
5 day extracorporeal circulation in animals

Bartlett and Gazzaniga, 1971
First successful ECLS patient, 1971
First cardiac ECMO survivor, 1972

Cardiac failure post-Mustard atrial baffle, 1972. (Courtesy of Robert Bartlett, MD)
First neonatal ECMO survivor, 1975

Esperanze, age 1 day, 1972. (Courtesy of Robert Bartlett, MD)
Venoarterial ECMO in a neonate

Courtesy of Robert Bartlett, MD
ECLS History: Clinical Trials

- Adult respiratory
  - 1979 NIH-ARDS randomized trial
  - 1986 Gattinoni ECCO₂R cohort trial
  - 1994 Morris ECCO₂R randomized trial
  - 2007 PEEK CESAR randomized trial

- Neonatal respiratory
  - 1985 Bartlett randomized trial
  - 1989 O’Rourke randomized trial
  - 1996 UK Collaborative trial
ECLS History: Devices

- **Vascular Access**
  - Direct cut-down
    - Chest tubes
    - Vascular cannulae
  - Seldinger technique
    - Thin walled cannulas
    - High flow double lumen cannulas

- **Anticoagulation**
  - Heparin titration to whole blood ACT
  - Non-thrombogenic surfaces
    - Passive
    - Active
ECLS History: Devices

- Membrane Lungs
  - Solid silicone rubber - Kolobow/Scimed/Medtronic
  - Microporous hollow fiber - Bentley/Terumo/Medtronic
  - Solid hollow fiber - Jostra/Maquet/Novalung

- Servo Regulated Pumps
  - Roller pump with negative pressure control
  - Centrifugal pumps with bearing-supported rotors – Biomedicus/Medtronics
  - Centrifugal pumps with floating rotors - Jostra/Maquet/Levatronics
ECLS History: Techniques

- **Respiratory Support**
  - Venoarterial via neck
  - Venovenous access via neck or groin
  - Arteriovenous access for CO₂ removal (AVCO₂R)

- **ECLS Management**
  - Dedicated ECLS specialists
  - ECLS-trained bedside nurses
  - Routine ICU procedure
Ambulatory lung assist
Life Support Research
Lessons from ECMO 1960-2011

- Prolonged extracorporeal circulation:
  - is possible with minimal complications
  - is life saving in severe heart and lung failure
  - allows study of vital organ failure, redefining “irreversible”

- Heart, lung, kidney “rest” with mechanical support is better than extremes of other management

- Critical Care grew into a hospital, nursing, and medical specialty.

- A generation of professionals has a better understanding of critical care pathophysiology

Courtesy of Robert Bartlett, MD
Life Support Research
Lessons from ECMO 1960-2011

- Successful Translational Research: mentoring, partnerships, persistence, dedication to patient care, good science, clinical trials, clinical practice
- Has a major impact on
  - Cardiopulmonary bypass and cardiac surgery
  - Critical care in all age groups
  - Clinical research in acute fatal illness
  - 3000 professional friends
  - 45,000 families
Extracorporeal Life Support Organization

- Established in 1989
- Outgrowth of a study group contributing to a registry of cases starting in 1984
- Focus on collection and sharing of data and experiences
  - Formal support of the Registry as an ELSO function
  - Annual meeting in Ann Arbor
- Fostered a rich collaboration among the majority of centers performing ECLS.
  - Surgeons, neonatologists, nurses, perfusionists, respiratory therapists, biomedical engineers
Active ECLS Centers

ELSO Registry through 2009
Recent activities

- Quality initiatives to help assure the best delivery of extracorporeal support
  - Center of Excellence Award
- Practice guidelines
- Guidance on specific practices through Task Forces
  - Infection control and management
  - Anticoagulation management
- Expanding education into the realm of simulation
  - Mark Ogino, MD and colleagues
Current and future directions

- Focusing on growth and recruitment of domestic centers
- Furthering an international presence
  - Establishment of international chapters/alliances
  - Web-based Registry for rapid collection and dissemination of information
- Exploring certification pathways for specialists
- Examining new models of ECLS delivery
  - Responding to the technical advances in equipment for extracorporeal support