OBJECTIVES

Past - Present - Future

Cardiac Pharmacology & Technique
Organs Monitoring & Protection
CPB & Coagulation Management
Minimally Invasive Cardiac Surgery

Revolution/Evolution in Cardiac Surgery & Anesthesia

Deep Hypothermic Beating Heart Surgery
CPB
Interventional Stem Cell Angiogenesis XenoTx
Robotics
MIDCAB
OPCAB
Inhalation Anesthetic
High Dose Narcotic
Balanced anesthesia/TIVA/Regional Anesthesia
FTCA (1-6 hrs)
Ultra-FTCA (OR, Awake?)

The Past – The Ice Age
Surface Hypothermia

• Wilfred Bigelow (Toronto): Experimental Hypothermia for Cardiac Surgery
  ➢ American Journal of Physiology, 1950

• C. Walton Lillehei (Minneapolis): Continue the work on hypothermia

John Gibbon Jr. - Philadelphia

• 1953 - May 6, Dr. John Gibbon Jr.
  The world’s first successful closure of an ASD in an 18 year old female by an extracorporeal circuit which consisted of a mechanical heart and lung
  The Gibbon heart lung machine

Significant Advancement in Cardiac Anesthesia

• PAC / TEE / IABP: Cardiac Pharmacology
• CPB Management: α stat, pH stat
• Fast-Track Cardiac Anesthesia & Recovery
• Perioperative Monitoring & Organs Protection
• Antifibrinolytic Drugs – Blood Management
• Post-Operative Pain Relief
• Perioperative Outcomes Improvement and Resource Utilization: EBM
• Genomic in cardiac outcomes
### Cardiac Anesthesia & Surgery

**First Publication: Anesthesiology 1946**

Harmel MH, Lamont A: Anesthesia in the surgical treatment of congenital pulmonic stenosis

<table>
<thead>
<tr>
<th>100 cases</th>
<th>Mortality rate 23%</th>
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<tbody>
<tr>
<td>Premedication</td>
<td>Morphine or Nembutol &amp; Atropine or Scopolamine (heavy sedation)</td>
</tr>
<tr>
<td>Induction</td>
<td>Cyclopropane or Vinesthene</td>
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<tr>
<td>Maintenance</td>
<td>Cyclopropane and/or Ether</td>
</tr>
</tbody>
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### Cardiovascular Response to Large Doses of Intravenous Morphine in Man

- **N Engl J Med, 1969**
- **Morphine Doses (0.5 to 3.0 mg per kg)**

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### J Earl Wynands, MD

- **High dose Fentanyl and hemodynamic response**
  - CJA 1981; 28: 314-20
- **MAC narcotic requirement CABG surgery**
- **Amrinone/Dobutamine in LCOS post CABG**
  - JCVA 1992; 6:542-55
- **Myocardial ischemia in CABG: PCB vs VCN**
  - Anesthesiology 1989; 70:230-6

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### Fast Track Cardiac Anesthesia & Recovery

- **Safety: morbidity & mortality**
- **Cost benefits, improve resource utilization**
  - Anesthesiology 85: 1300-10, 1996
- **Cost reduction: one-year follow up**
  - Anesthesiology 98: 651-7, 2003
- **Evidence-based perioperative clinical outcomes research**
  - Anesthesiology 102: 188-203, 2005

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### Cardiology

- **Early gene expression profiles during intraoperative myocardial ischemia-reperfusion in cardiac surgery**
  - J Thorac Cardiovasc Surg 2007; 134:8-14

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### Edward Lowenstein, M.D.

- **Cardiovascular Response to Large Doses of Intravenous Morphine in Man**
  - Morphine Doses (0.5 to 3.0 mg per kg)
Future Projections

- Safety, Cost-Effectiveness and Evidence-Based Practice
- MOA Anesthetics, Pharmacology, Technique
- Model of Cardiac Care
- Genomic and Risk Stratification
- ‘Personalized’ Perioperative Medicine

Emerson Moffitt, M.D.

- Extracorporeal Circulation: Relationship of Blood Flow and Volume
  - Surgical Forum, 1957

- Cardiac Support with the Gibbon Oxygenator
  - Anesthesiology, 1957

CPB and Neurological Management

- Cerebral autoregulation and Flow/Metabolism
  - Anesthesiology 68: 825-32, 1987
- Assessment of neurocognitive function
- Monitoring brain oxygen
- Neuroprotection

Imaging Modality

- Cardiac Cath
- TEE
- MRI
- PET
- Echo
- CT
- SPECT

Organs Monitoring & Protection

- Specific target organs monitoring and protection (brain, heart, kidney)
- Decrease utilization of PAC and increasing TEE (portable)
- Multi-functional IVUS (+ enhancements) achieves widespread acceptance and use
- MRI and CT techniques evolve further as versatile non-invasive high resolution diagnostic modalities
- Gene induced Angiogenesis
- Stem Cell therapy to restore organ function
**Coagulation Monitoring**

- **TEG**
  - Whole blood test of viscoelastic blood clot formation
- **Ultegra**
  - Platelet response to a thrombin receptor agonist peptide (TRAP)
- **Clot Signature Analyzer (CSA)**
  - Measure platelet reactivity
- **Plateletworks**
  - Platelet count ratio to assess platelet reactivity

**High Risks Patients:**
1. Redo CABG and valve replacement
2. Initial or repeat combined valve replacement and CABG
3. Multiple valve replacement
4. Others - Bental procedures and adult congenital heart procedures
5. Multiple Co-morbid illness

**Colloids: Hydroxyethyl Starches**

**Objectives:**
- Low MW
- Low MS
- High C2/C6

**Future Projections**

- Extracorporeal Circuit:
  - Use of new non-thrombogenic materials
  - Simplified and miniaturized ECC
  - Total automation of the ECC
- Blood Management: Techniques & Pharmacology
- Oxygen Therapeutics
- Bloodless cardiac surgery

**Surgical Coronary Artery Revascularization Platform**

- **Arrested Heart**
  - Conventional Surgery
  - MICS
- **Beating Heart**
  - OPCAB
  - MVST
  - Endo
  - HYBRID
Mitral Valve Repair

- Channel
- Patency
- Angiogenesis
- Neurogenic
- Placebo

Future Projections

- Minimally invasive coronary and valve surgery
- Robotic hybrid procedure
- Interventional cardiovascular procedures – transcatheter valve, aortic endovascular
- Anesthesia imperative to complement the advancement in Biotechnology – cell regeneration

TAVR

- Preop evaluation: Severe AS, CAD, poor Euroscore
- Monitoring: ECG, SaO2, Arterial line, CVP, TEE
- GA balanced anesthesia
- Preload, afterload, HR control, rapid ventricular pacing for valve deployment
- Complications: Tamponade, iliac artery/aorta vascular rupture, bleeding, L pleural effusion

Minimally Invasive Cardiac Surgery

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