medigraphic Artemisa en línea

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Cardiac Anesthesia & Surgery: Past, Present & Future

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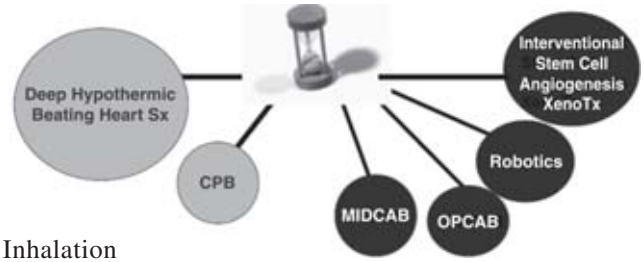
OBJECTIVES

The Past, Present, Future
↓
Cardiac Pharmacology & Technique
↓
Organs Monitoring & Protection
↓
CPB & Coagulation Management
↓
Minimally Invasive Cardiac Surgery

REVOLUTION/EVOLUTION IN CARDIAC SURGERY & ANESTHESIA



Inhalation Anesthetic

High Dose Narcotic
Balanced anesthesia/TIVA/Regional Anesthesia
FTCA (1-6 hrs)
Ultra-FTCA (OR, Awake)

EXTRACORPOREAL MILESTONES

- 1915 - Jay McLean discovered the anticoagulant effect of heparin.
- 1927 - Dr. Charles Best, Toronto, proceeded to purify heparin and reported on his research.
- 1937 - Dr. John Gibbon employed the first use of heparin in an extracorporeal circuit to successfully perfuse cats.

DEBAKEY ROLLER PUMP

- 1937 - DeBakey recognized the dependability of the roller pump as a reliable mechanism for milking large volumes of blood along a flexible piece of tubing.
  It is still used as the premier bloodpumping system in the operating room.

SURGICAL MILESTONES

- 1938 - Dr Robert Gross, of Boston Children's Hospital, performed the first successful ligation of a patent ductus on a seven year old female patient.
- 1940 - Dr. Gordon Murray, of Toronto, described his clinical experience with his surgical approach to the mitral valve using a valvulotome.

CARDIAC ANESTHESIA & SURGERY

First Publication: Anesthesiology 1946
Harmel MH, Lamont A: Anesthesia in the surgical treatment of congenital pulmonic stenosis

100 cases	Mortality rate 23%
Premedication	Morphine or Nembutol & Atropine or Scopolamine (heavy sedation)
Induction	Cyclopropane or Vinesthene
Maintenance	Cyclopropane and/or Ether
	Spontaneous assisted ventilation
	A few patients not intubated
	No postoperative chest drain

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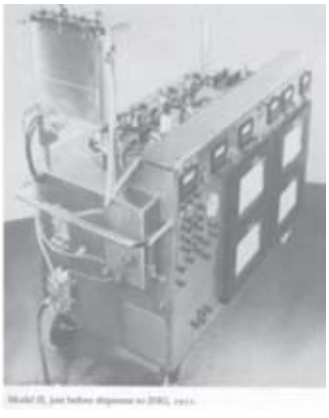
SURGICAL MILESTONES: SURFACE HYPOTHERMIA

- Wilfred Bigelow (Toronto): Experimental Hypothermia for Cardiac Surgery
  - American Journal of Physiology, 1950 direct closure of an ASD, under direct vision, utilizing short (6 minute) periods of tolerance to inflow occlusion under the conditions of moderate surface hypothermia.
- C. Walton Lillehei (Minneapolis): had heard Bigelow present his animal research work on hypothermia and went to work in his own lab studying its effect.

THE PAST – THE ICE AGE



WILLIAM T. MUSTARD - TORONTO

- 1951- Dr. Mustard performed his monkey lung experiments. Mustard suspended the monkey lungs inside bell jars, into which pure oxygen was forced and linked the lungs with tubing that connected to a pump. After priming with human blood, Mustard would hook up the patient.

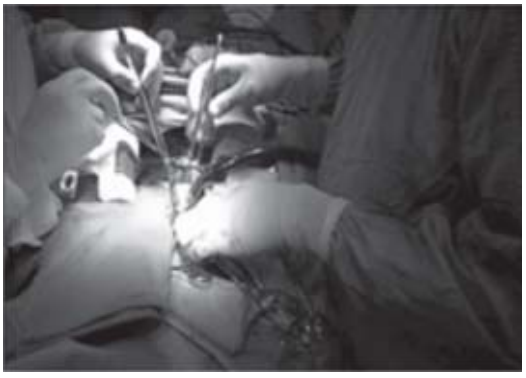
CAMPBELL COWAN BIOLOGIC OXYGENATOR, 1952

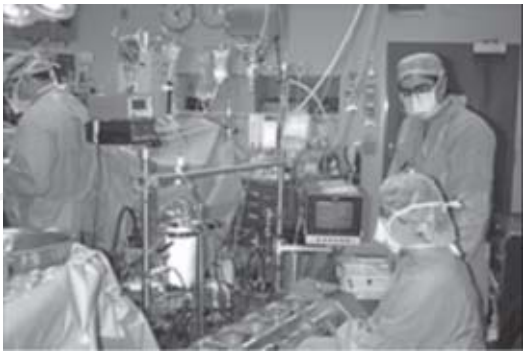
- 21 cases
- 3 survivors

JOHN GIBBON JR. - PHILADELPHIA

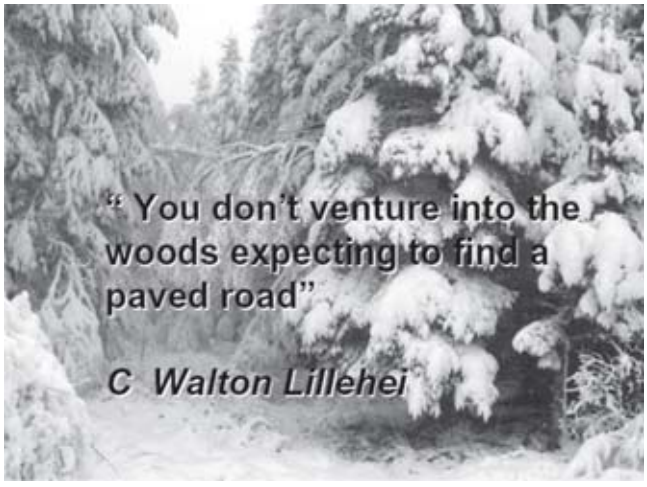
- 1953 - May 6, Dr. John Gibbon Jr. performed the world's first successful closure of an ASD in an 18 year old female while her cardiorespiratory function was maintained by an extracorporeal circuit which consisted of a mechanical heart and lung
  The Gibbon heart lung machine

THE PRESENT - THE CPB AGE





4TH INTERNATIONAL CONGRESS ON THORACIC & CARDIOVASCULAR SURGERY, BEIJING 1997

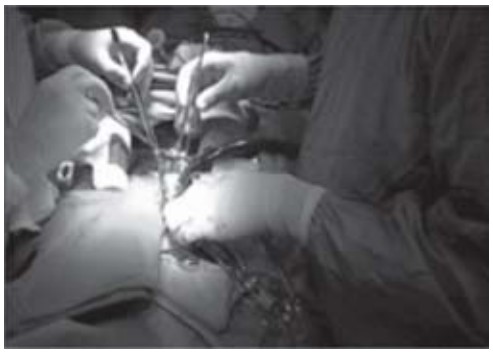


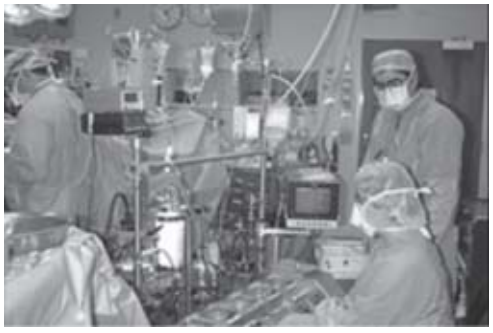
«And don't give me any of those
local anesthetics.
Get me the imported stuff».

SIGNIFICANT ADVANCEMENT IN CARDIAC ANESTHESIA

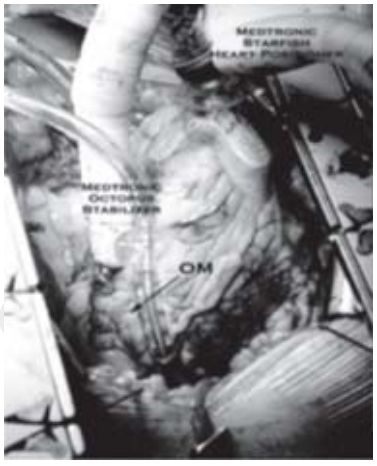
- PAC/TEE/IABP: Cardiac Pharmacology
- CPB Management
- Fast-Track Cardiac Anesthesia & Recovery
- Perioperative Monitoring & Organs Protection
- Antifibrinolytic Drugs – Blood Management
- Post-Operative Pain Relief
- Perioperative Outcomes Improvement and Resource Utilization: EBM

THE PRESENT - THE CPB AGE





PRESENT / FUTURE – THE MICS AGE



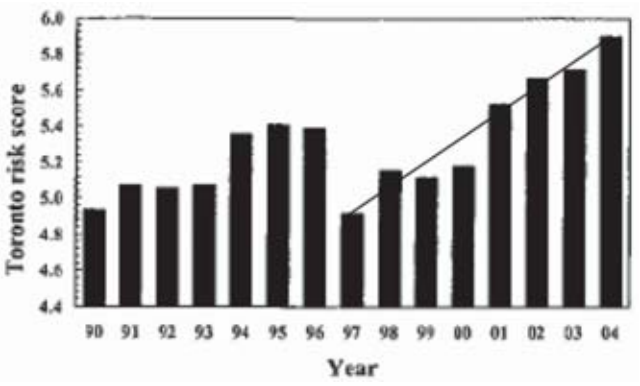
CARDIAC SURGERY
A HISTORICAL VIGNETTE

«Advance in anesthesia, membrane oxygenators, heat exchangers and myocardial protection have challenged surgeons to invent new procedures for all kinds of cardiac anomalies».

Norman Shumway
Can J Cardiol 21:
1066-1068, 2005

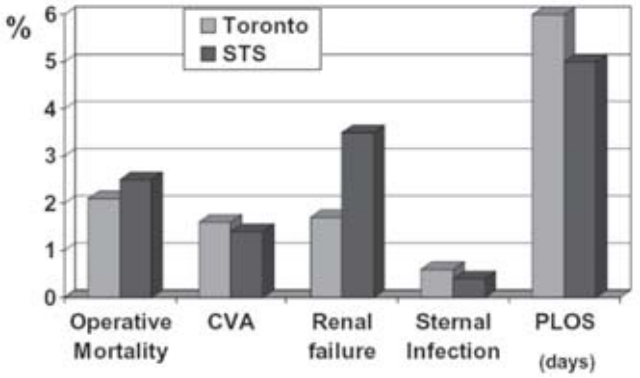
Profile (%)	Toronto (n > 12 K)	STS (n > 600 K)
Age (yr)	62	65
Female	27	28
Urgent Sx	42	45.3
Emergent Sx	2.8	4.3
Redo Sx	9.5	8.2
NYHA Class IV	48	21
Triple VD/LM	46/14	74.9/26
DM	23	35.7
PVD	12	15.6
Hypertension	48	76.6
Renal Dialysis	1.2	1.5
Renal Failure	5.1	5.3
COPD	4.3	19.2

INCREASING RISK FACTORS IN CABG PATIENTS



Any Adverse Event	9.8%	8.6%

POSTOPERATIVE OUTCOME (%)



1) Ivanov et al. Can J Cardiol 2006; 22: 221-7
2) STS Report 2006

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TODAY TO TOMORROW

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Induction	Cyclopropane or Vinesthene
Maintenance	Cyclopropane and/or Ether Spontaneous assisted ventilation A few patients not intubated No postoperative chest drain

EDWARD LOWENSTEIN, M.D.

- Cardiovascular Response to Large Doses of Intravenous Morphine in Man
  – N Engl J Med, 1969
- Morphine Doses (0.5 to 3.0 mg per kilogram of body weight)

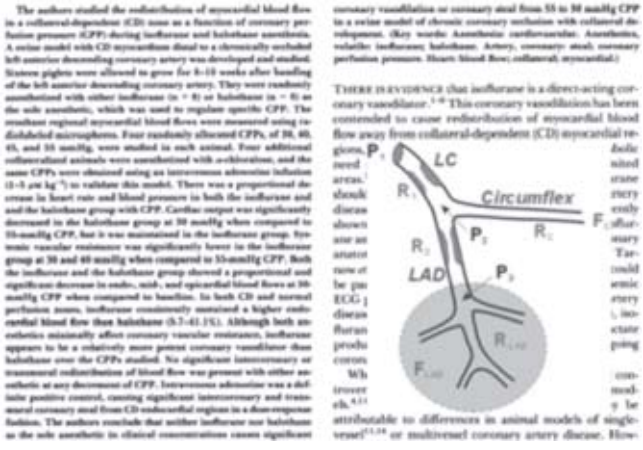
EDWARD LOWENSTEIN, M.D.

«It is challenging to describe briefly the milieu and circumstances that set the stage for a new concept of anesthesia for our most dreadfully ill patients. At least three things were necessary:

- An environment that tolerated and even encouraged radically creative solutions;
- A clinical problem that caused an unacceptably high death rate;
- A cast of characters with imagination, vision, courage, and clinical credibility»

ISOFLURANE–A POWERFUL CORONARY VASODILATOR IN PATIENTS WITH CORONARY ARTERY DISEASE

DOSE–RESPONSE RELATIONSHIP OF ISOFLURANE AND HALOTHANE *VERSUS* CORONARY PERFUSION PRESSURES



FAST TRACK CARDIAC ANESTHESIA & RECOVERY

- Safety: morbidity & mortality
  J Thorac Cardiovasc Surg 112:755- 64, 1996
- Cost benefits, improve resource utilization
  Anesthesiology 85: 1300-10, 1996
- Cost reduction in oneyear follow up
  Anesthesiology 98: 651-7, 2003

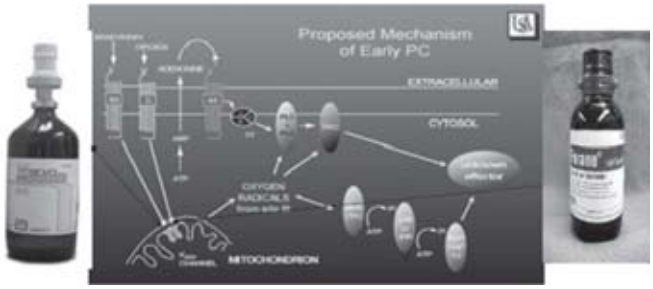
FTCA: REMIFENTANYL *VS* FENTANYL PRDB MULTI-CENTERS STUDY

Propofol induction and infusion, VCB/NBX, REMI 1 ug/kg/min *vs* FENT 10 ug/kg, ISO

Median	REMI (n = 150)	FENT (n=154)
Extubation (h)	3.3	3.3
Less Monitor (h)	7.8	7.0
ICU LOS (d)	1.1	1.0
Hospital LOS (d)	5.0	4.9

Cheng D, Newman M, et al. Anesth Analg 2001; 92: 1094
Howie M, Cheng D, et al. Anesth Analg 2001; 92: 1084

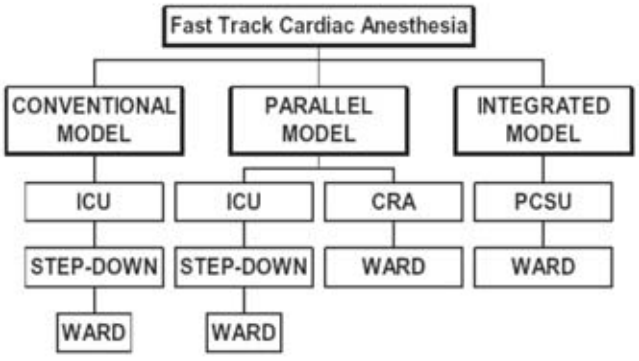
VOLATILE ANESTHETICS: PRECONDITIONING



ANESTHETIC AGENTS: MOA

- GABA receptor
  Propofol, thiopental, inhalational agents
- NMDA receptor
  Nitrous oxide, ketamine, xenon
- Receptor-synapse based/kinetics of cellular events

CARDIAC SURGICAL RECOVERY MODELS



Cheng D, et al. Crit Care Med 1999; 27: 2321-3

IMPACT OF THE OPENING OF A SPECIALIZED CARDIAC SURGERY RECOVERY UNIT ON POSTOP OUTCOMES

In Hospital Mortality

	Predicted	Observed
2004/5	2.1 ± 3.0%	17/967 (1.8%)
2005/6	2.5 ± 4.4%	16/979 (1.6%)
p value	0.08	0.86

Incidence of Major Complications

	Predicted	Observed
2004/5	14.7 ± 8.4%	127/967 (13.1%)
2005/6	15.3 ± 8.2%	96/979 (9.8%)
p value	0.22	0.003

Novick, Cheng, et al. SCA, 2006

PUBLIC *VS* PRIVATE INSTITUTIONAL PERFORMANCE REPORTING

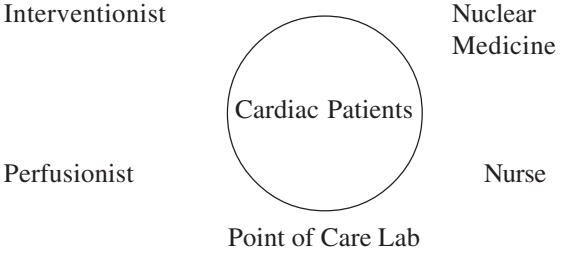
- Longitudinal study (1991-2002): 67,693 Ontario CABG surgery pt
- 30-day mortality rate decreased by 29% between no reporting (1991-1993) and confidential reporting (1994-1998)
- No further decrease with public reporting (1999-2001)
- Confidential disclosure of outcomes is sufficient to accelerate Quality
  Improvement in a public health care system

Guru, Fremes, Naylor. Am Heart J 2006;152:573-8

rapid.com

PARADIGM SHIFT IN MANAGEMENT OF CARDIAC SURGERY PATIENTS

CARDIAC ANESTHESIOLOGIST (PERIOPERATIVE MEDICINE)



CARDIAC PHARMACOLOGY & TECHNIQUE

Future Projections

- Genomic and Risk Stratification
- 'Personalized' 'Perioperative' Medicine
- MOA Anesthetics
- Safety, Cost-Effectiveness and Evidence-Based Practice

TODAY TO TOMORROW

Cardiac Pharmacology & Technique
↓
Organs Monitoring & Protection
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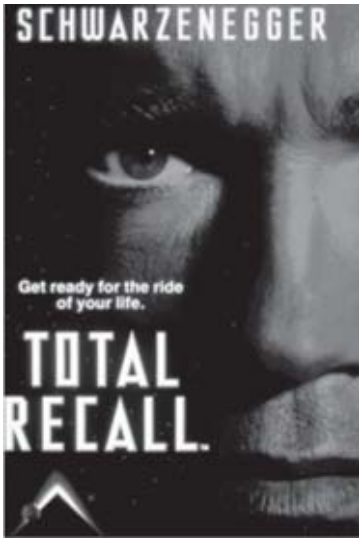
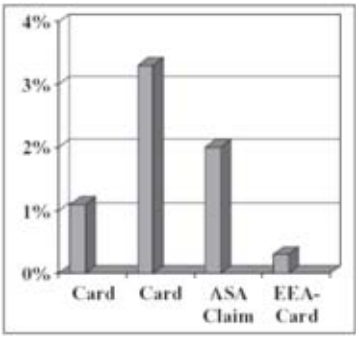
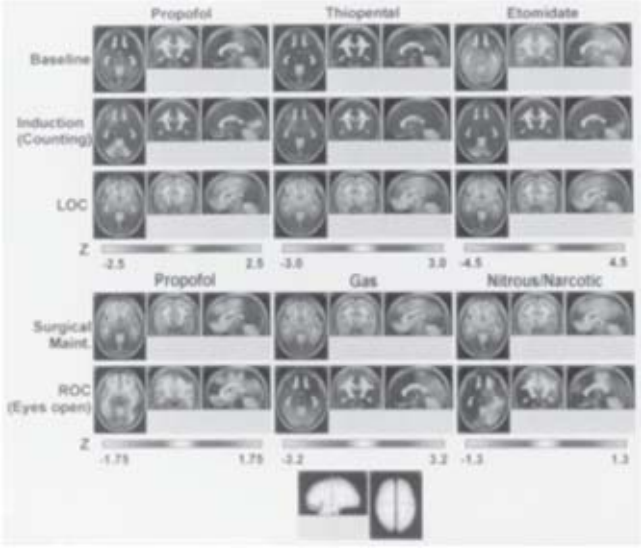


FTCA: INTRAOPERATIVE AWARENESS

- Last memory before surgery:
  Holding Area / OR:
  (n = 608) 100%
- Next memory:
  ICU: (n = 606) 99.7%
  Intraop: (n = 2) 0.3%
  0%

Dowd N, Cheng D, et al. Anesthesiology 1998;89:1068



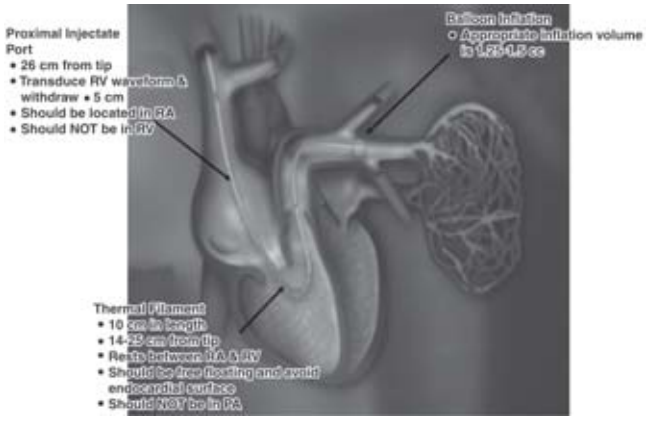


John ER et al. Conscious Cogn 10:165-183, 2001
Depth of Anesthesia - CATEEM, BIS, SFI

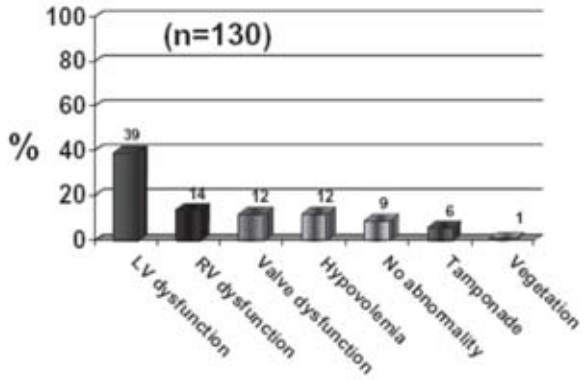
INVOS 5100 CEREBRAL OXIMETER (NIRS – NEAR INFRARED REFLECTANCE SPECTROPHOTOMETRY)

Trans-Cranial Doppler (TCD)

SWAN-GANZ® VOLUMETRIC THERMODILUTION CATHETER



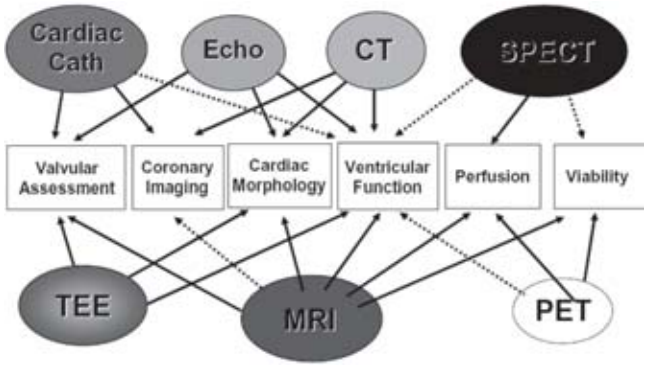
TEE DX IN UNEXPLAINED HEMODYNAMIC INSTABILITY AFTER CARDIAC SURGERY



- In 58.5% of the unstable patients, clinical management was changed by TEE result
- In surgical intervention, mortality is improved

Wake P, Ali M, Cheng D, et al. Can J Anesth 48:778-83, 2001

IMAGING MODALITY



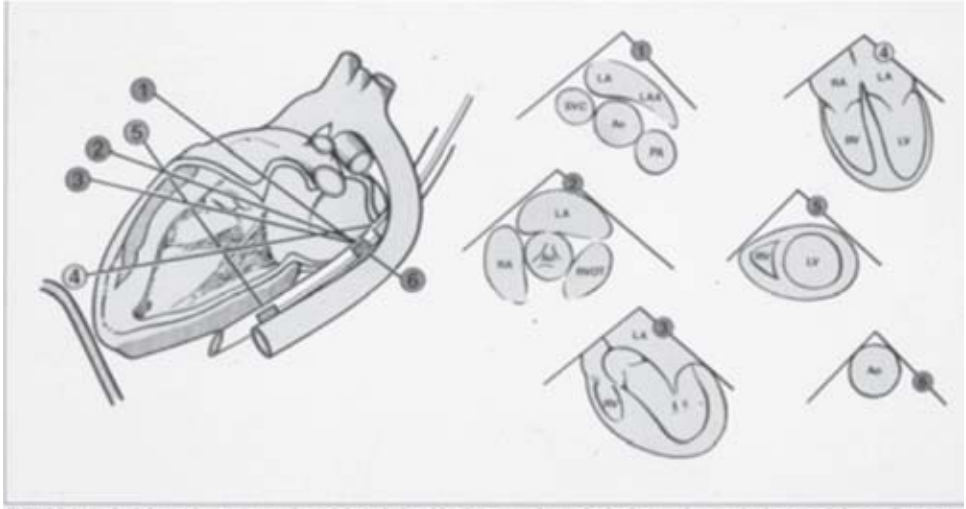
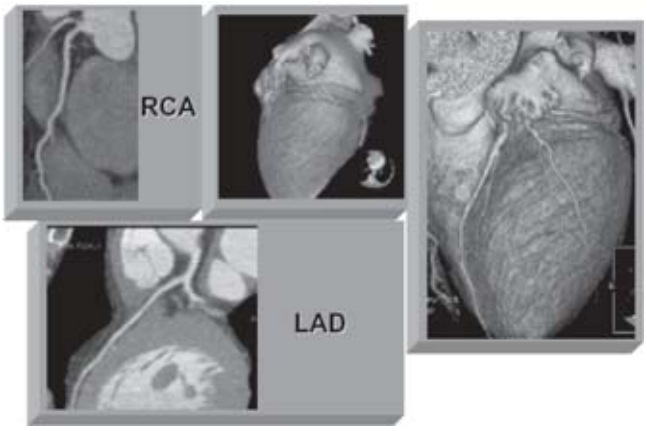
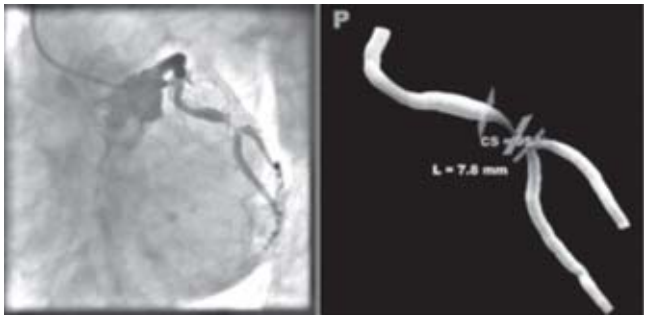


FIGURE 1. (Left) Schematic representation of the relationships between the probe in the esophagus, the heart and descending aorta. Scans are made on six planes across the structures. (Right) [1] and [2]: basal view, [3] two chamber view, [4] four chamber view, [5] transgastric view, [6] scan of descending aorta. A: atrium, LAA: Left atrial appendage, SVC: superior vena cava, AO: aorta, PA: pulmonary artery, RA: right atrium, RVOT: right ventricular outflow tract, RV: right ventricle.

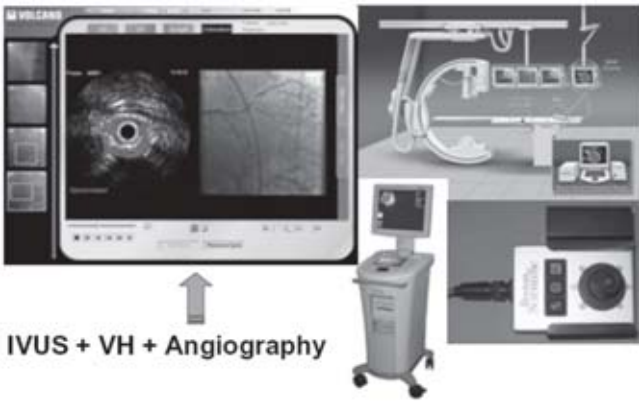
CORONARY CTA



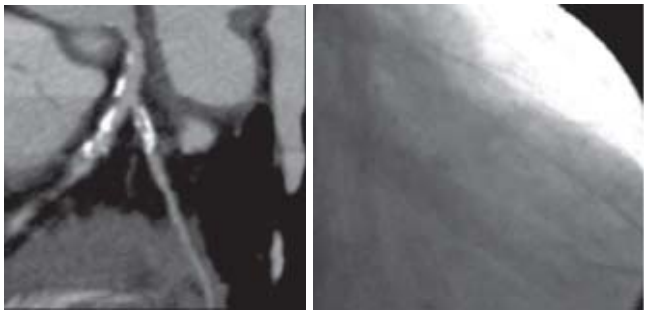
3D ANGIOGRAPHY
(using image reconstruction techniques)



FULLY INTEGRATED IVUS SYSTEMS

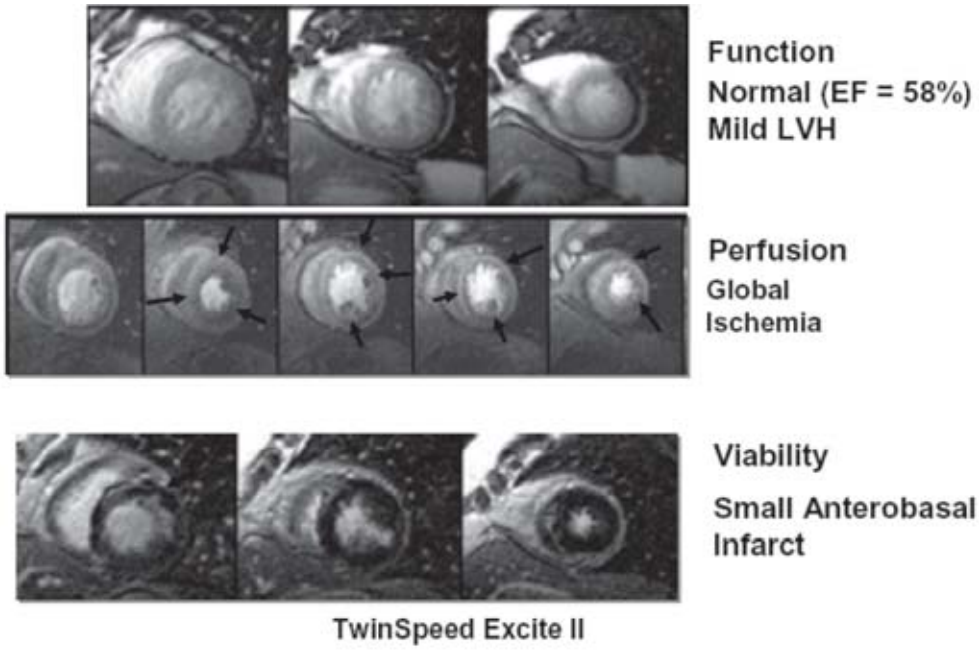


CALCIFIED PLAQUE: 1ST DIAGONAL



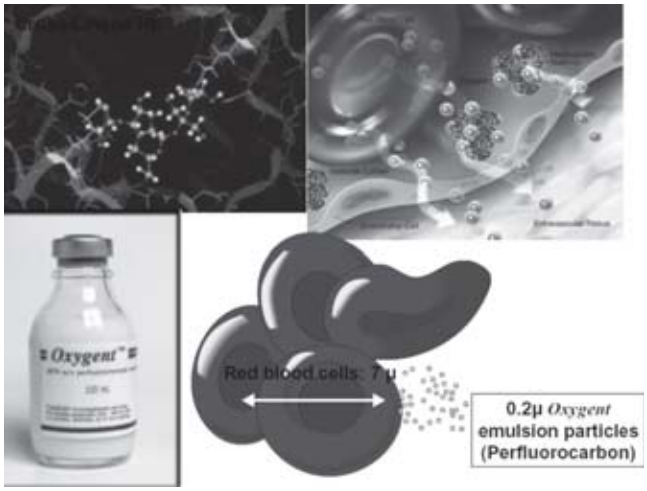
CTA Cath

NON-INVASIVE FUNCTIONAL AND MORPHOLOGICAL IMAGING

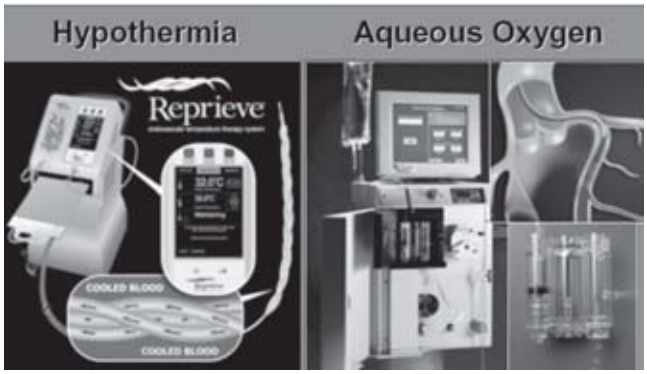


MYOCARDIAL PRODUCTION THE PRESENT

- Temperature: Tepid
- Direction: Combined, continuous when possible
- Composition: Arrest- Perfuse- Protect
  K+ lowest to induce arrest
  Mg++ to facilitate arrest and protect
- Additives: Insulin, adenosine, L-Arginine, Beta-adrenergic blocker



NOVEL DEVICES TO REDUCE INFARCT SIZE

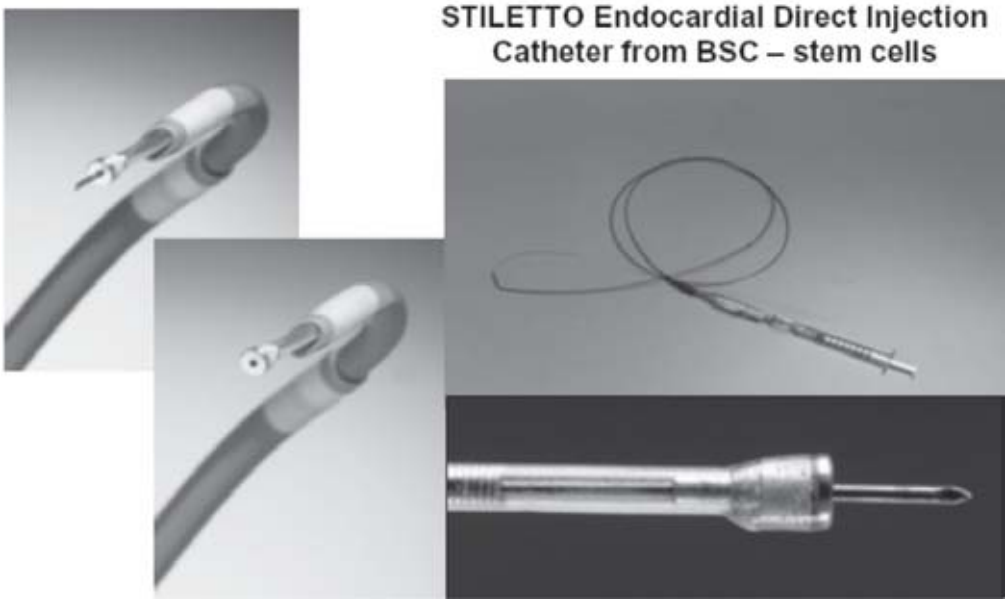


ORGANS MONITORING & PROTECTION

Future Projections

- Specific target organs monitoring and protection (brain, heart)
- Decrease utilization of PAC and increasing TEE
- Multi-functional IVUS (+ enhancements) achieves wide-spread 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 heart function

DIRECT INTRA-MYOCARDIAL INJECTIONS: STILETTO™



TODAY AND TOMORROW

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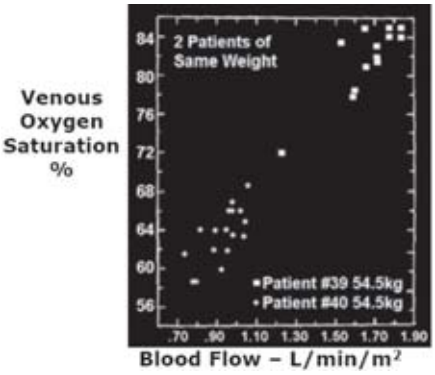
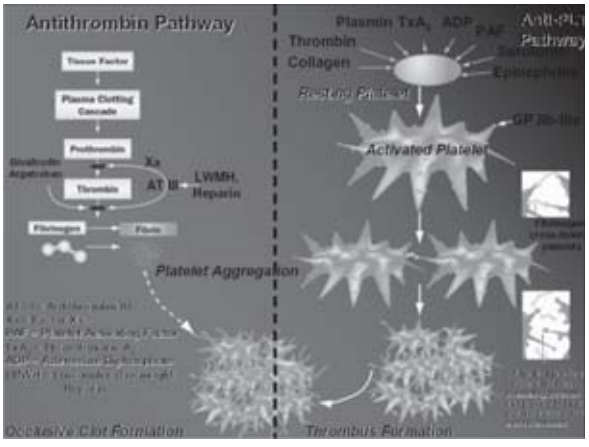
Minimally Invasive Cardiac Surgery

EMERSON MOFFITT, M.D.

- Extracorporeal Circulation: Relationship of Blood Flow and Volume
  - Surgical Forum, 1957
- Cardiac Support with the Gibbon Oxygenator
  – Anesthesiology, 1957

RELATION OF VENOUS OXYGEN SATURATION TO BLOOD FLOW DURING TOTAL PERFUSION





COAGULATION MONITORING

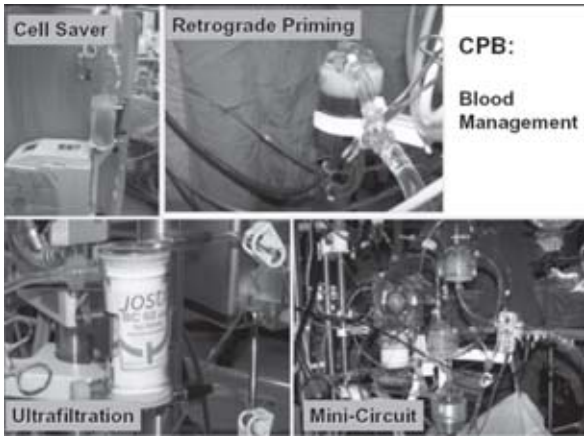
- **TEG**
  whole blood test of viscoelastic blood clot formation
- **Ultegra**
  platelet response to a thrombin receptor agonist peptide (TRAP)
- **Clot Signature Analyzer (CSA)**
  measure platelet reactivity
- **Plateletworks**
  platelet count ratio to assess platelet reactivity

BLOODLESS SURGERY

Ott DA, Cooley DA. Cardiovascular surgery in Jehovah's Witnesses. Report of 542 operations without blood transfusion. JAMA. 1977 Sep 19;238(12):1256-8.

Jehovah's Witnesses who require operation represent a challenge to the physician because of the patients' refusal to accept blood transfusion. We report a *20-year experience* with a consecutive series of 542 Jehovah's Witness patients ranging in age from 1 day to 89 years who underwent operation. *Early mortality (within 30 days after operation) was 9.4%*. In 362 patients requiring temporary cardiopulmonary bypass, early mortality was 10.7%. Mortality was 13.5% among 126 patients who had single- or double-valve replacement. The only deaths among patients who had aortic valve replacement or repair of a ventricular septal defect occurred in those who had some serious complication before operation. Preoperative or postoperative anemia was a contributing factor in 12 deaths, and *loss of blood was the*

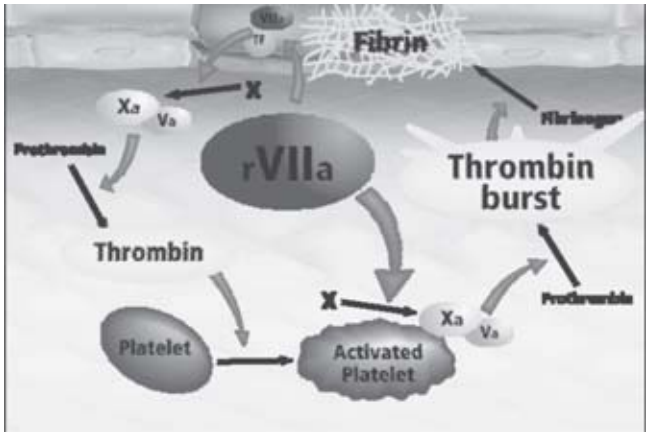
direct cause of three deaths. Cardiovascular operations can be performed safely without blood transfusion.




U.S. Food and Drug Administration


Mortality Associated With Aprotinin During 5 Years Following Coronary Artery Bypass Graft Surgery

RFVIIA MECHANISM OF ACTION: BOOSTS THROMBIN GENERATION ON ACTIVATED PLATELETS



CPB & Coagulation Management

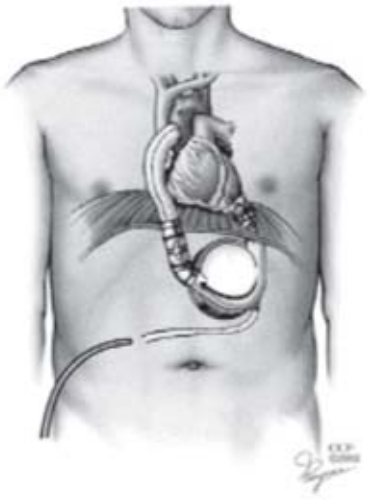
Future Projections

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

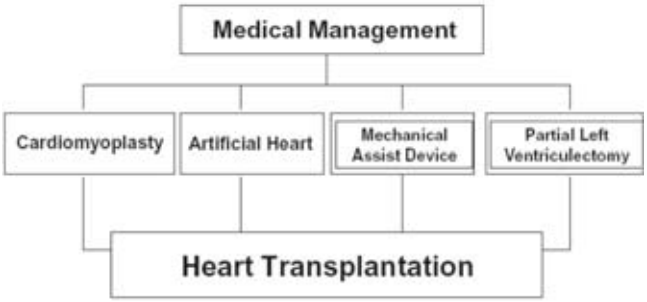
TODAY TO TOMORROW

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

TCI-HEARTMATE LVAD



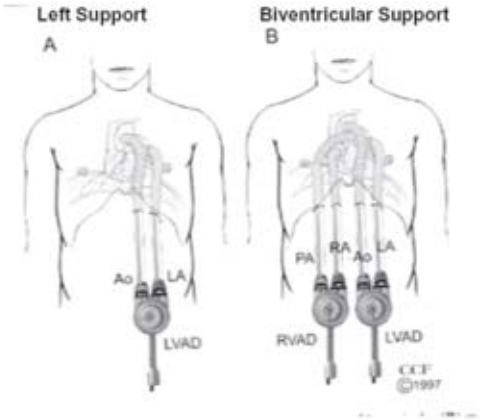
END STAGE CHF: TREATMENT OPTIONS



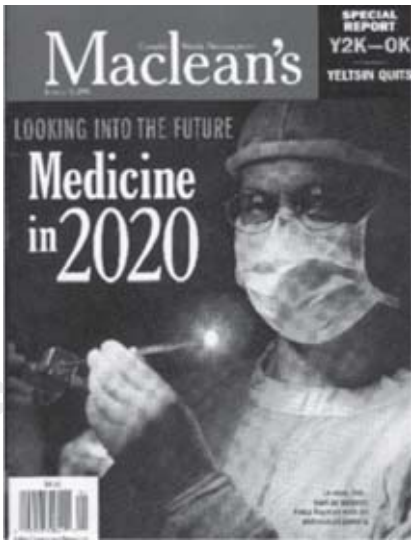
VENTRICULAR ASSIST DEVICES

- Extracorporeal pulsatile pump:
  ABIOMED BVS 5000, Thoratec Assist
- Intracorporeal implantable:
  HeartMate, Novacor – LVAD
  ABIOCOR, TAH

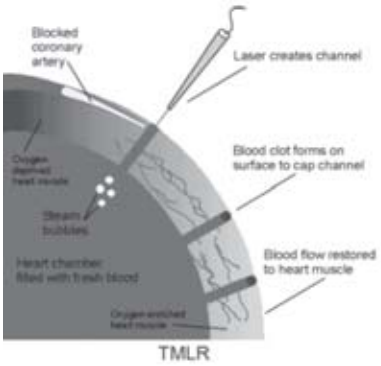
THORATEC VENTRICULAR ASSIST DEVICE



Naughton P and Bashour CA.
Semin Cardiothorac Vasc Surg 6:237-57. 2002

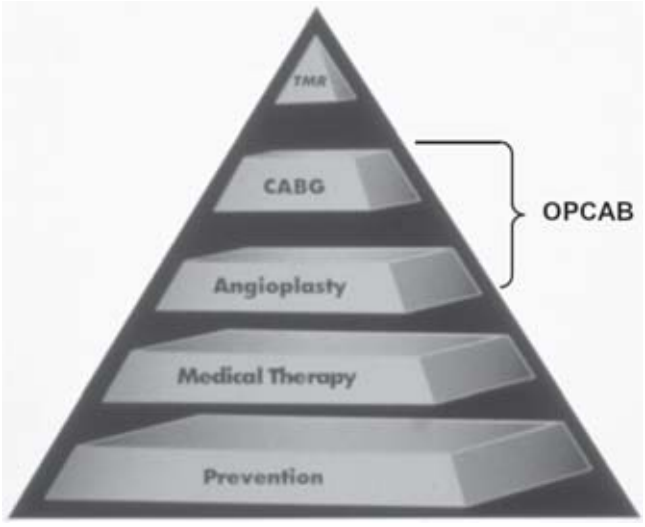


TMR: MECHANISM OF ACTION?

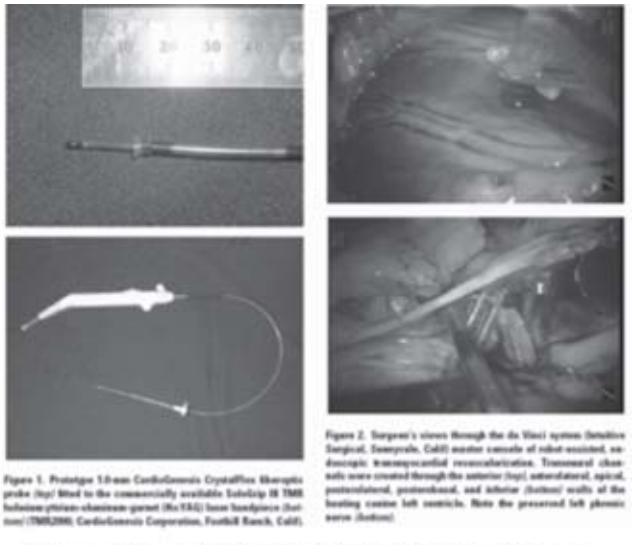


- Channel Patency
- Angiogenesis
- Neurogenic
- Placebo

HYBRID OR: LHSC



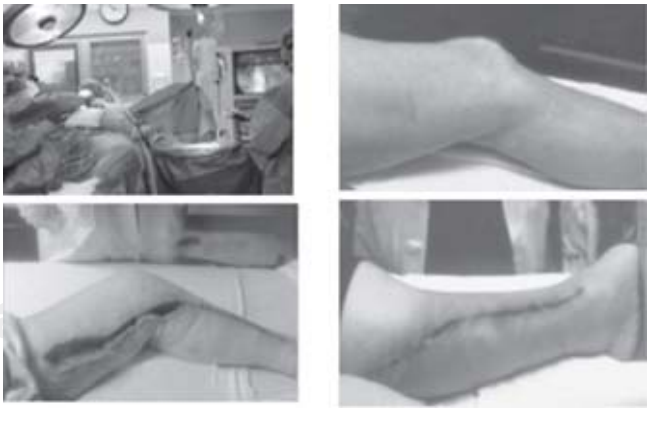
TRANSMYOCARDIAL REVASCULARIZATION



Yuh DD et al. J Thorac Cardiovasc Surg 13:120-4, 2005

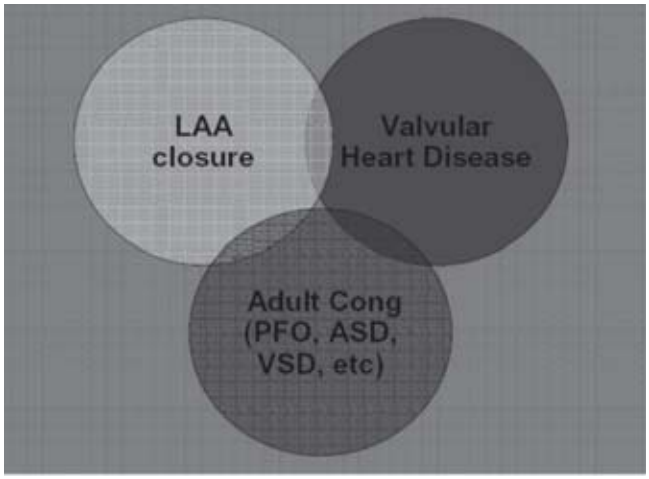
SURGICAL TECHNIQUE: ENDOSCOPIC VEIN HARVESTING

wound drainage, necrosis, infection, and leg edema

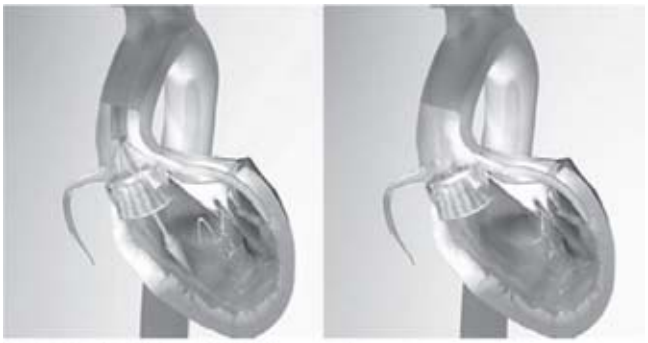


Cheng, Allen, Cohn, et al. Innovations 2005; 1: 61-74

PERCUTANEOUS INTERVENTION FOR STRUCTURAL HEART DISEASE



THE LOTUS™ VALVE BY SADRA MEDICAL

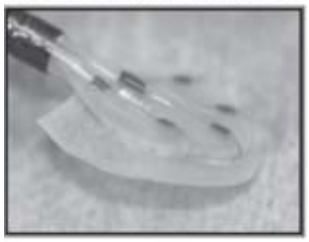


▶ Expand percutaneous valve and reposition

▶ Final release

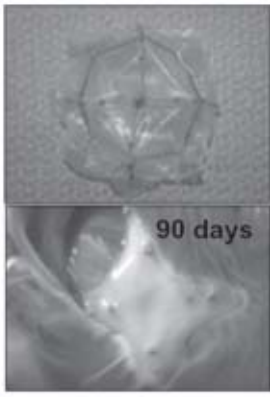
NEW PFO CLOSURE DEVICES

RF closure - Cierra



"No device" approach

BioSTAR™ - NMT

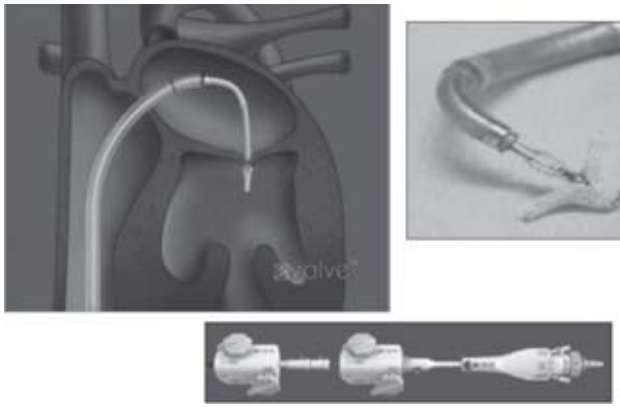


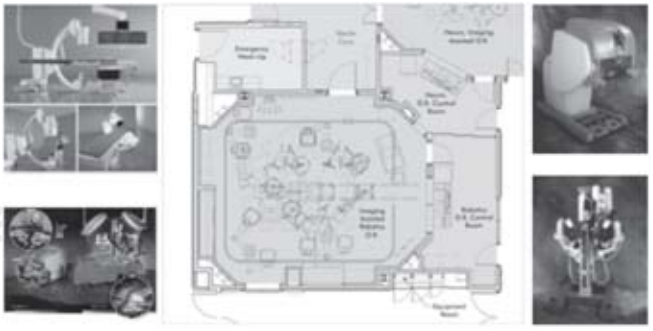
Bioabsorbable

PRESENT / FUTURE – THE BIO-TECHNOLOGY AGE

- Interventional Cardiology
- Hybrid procedure
- Angiogenesis
- Tissue Engineering
- Xenotransplant
- Stem cell therapy

ENDOVASCULAR MITRAL REPAIR SYSTEM (EVALVE)



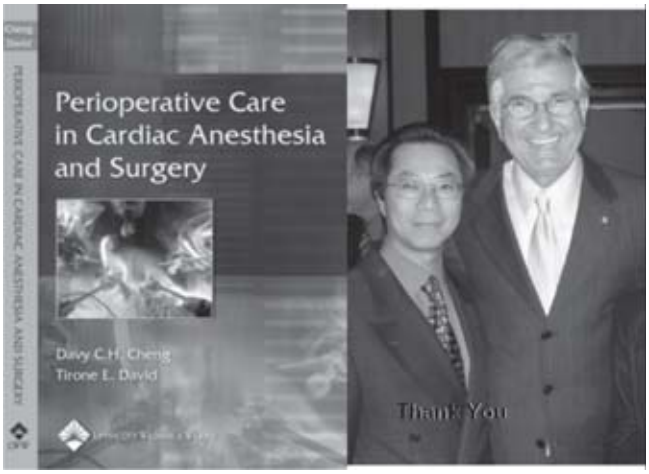


Robotics Operating Suite Floor Plan - Level 2

MINIMALLY INVASIVE CARDIAC SURGERY

Future Projections

- Minimally invasive coronary and valve surgery
- Robotic hybrid procedure
- Interventional cardiovascular procedures
- Anesthesia imperative to complement the advancement in Biotechnology



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