

Cardiac surgery – Introduction

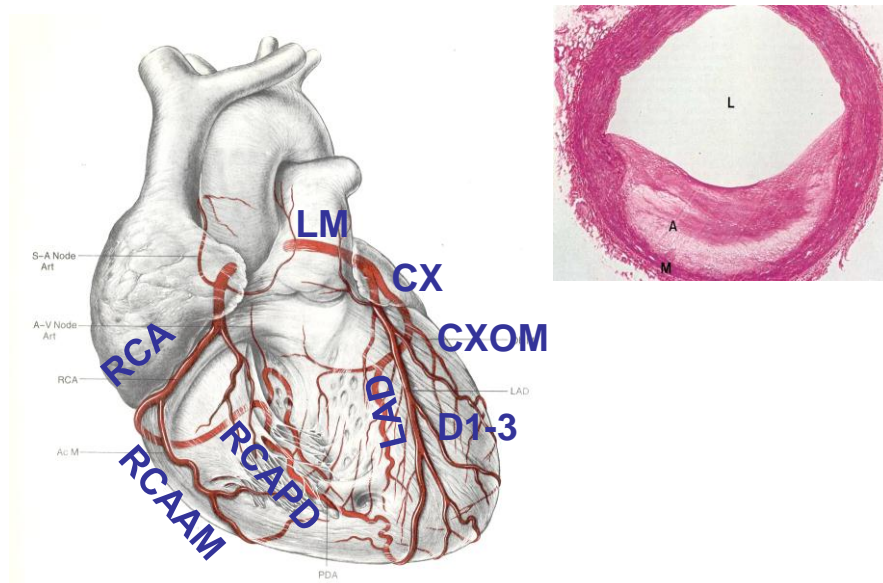
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University of Pécs, Heart Institute



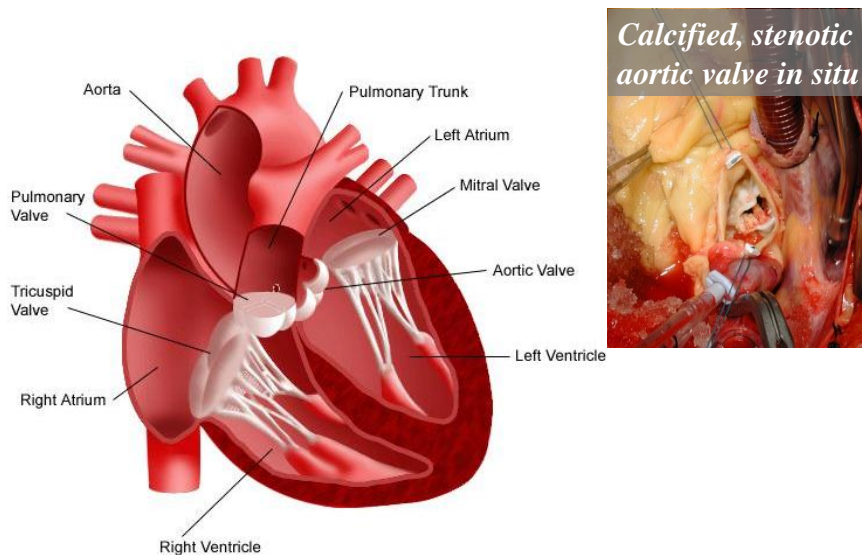
Pécs, 2015



The anatomy of coronary arteries



The anatomy of the heart



Most common types of heart operations

- coronary bypass grafting (CABG)
- valve replacement (AVR, MVR, TVR)
- valvuloplasty - repair (tricuspid, mitral – TVP, MVP)
- congenital (VSD, ASD, DBP...)
- operations on thoracic aorta (asc., arch)
- aneurysmectomy, aneurysm-plication
- heart transplantation and its alternatives
- pacemaker implantation

combined operations (CABG+valve, CABG+carotid endarterectomy, CABG+aneurysmectomy)

Milestones of cardiac surgery



Theodore Billroth
(1821-1894): *'Any surgeon who would attempt operation on the heart should lose the respect of his colleagues'*.



Ludwig Wilhelm Carl Rehn
(1849-1930)
First successful myocardial suture: **1896**

The requirements for modern cardiac surgery

- diagnostic background (coronarography, echo)
- asepsis, antibiotics
- transfusiology
- hemostaseology
- anesthesiology - intensive care
- extracorporal circulation
- myocardium protection
- operative technique
- artificial valves, other prostheses

Milestones in cardiac surgery

1896. Rehn (G, 1849-1930) successfully sutures a heart wound

1925. Souttar (UK, 1875-1964) – closed mitral commissurotomy

1928. Forssmann (G, 1904-1979) – first cardiac catheterization via cephalic vein on himself

1939. Gross (USA, 1905-1988) – ligation of ductus Botalli

1950-s Gibbon, Kirklin, Lillehei - ECC

1951. Vineberg a. thoracica interna implantation

Favaloro, Effler v. saphena bypass

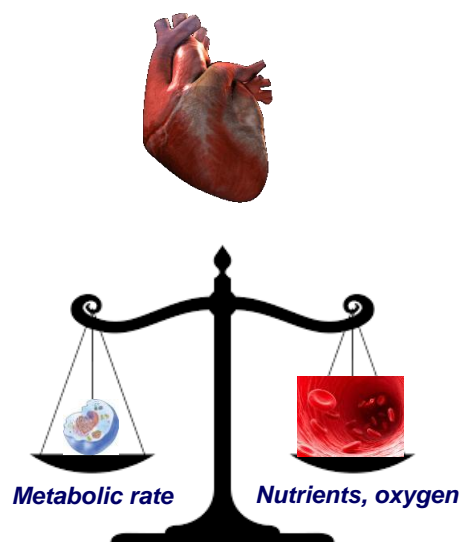
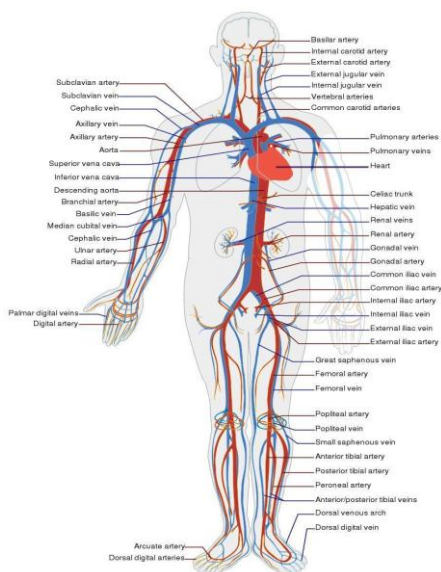
1953. ASD operation

1955. VSD operation

1964. Kolesov a. thoracica interna-LAD bypass

1968. Green a. thoracica interna-LAD bypass

The circulation – ischemic damage



The making of the heart-lung machine

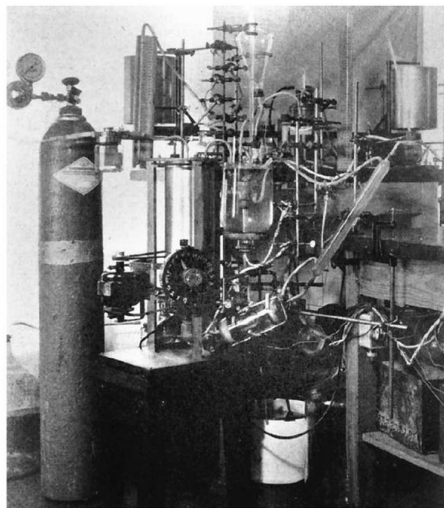
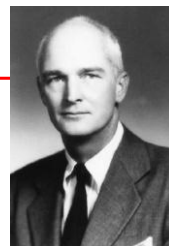


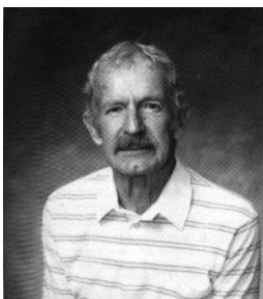
Fig 2. Photograph taken in Dr Gibbon's laboratory, showing an early version of his heart-lung machine. (Courtesy of J. H. Gibbon, Jr. Reprinted with permission from Gibbon JH et al. Arch Surg. 1937; 34:1109.)

John Gibbon
(1903-1973)



May 6th 1953. The first successful ASD closure with the usage of heart lung machine (IBM).

Hypothermia – other arm of the scale



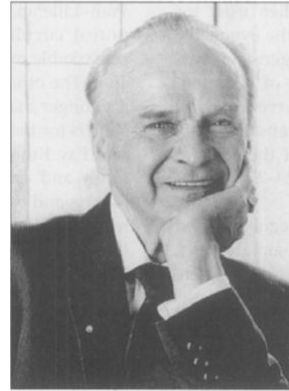
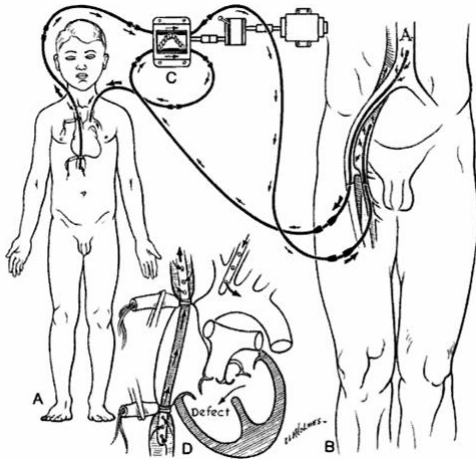
JF Lewis (1916-1993)

1953. Lewis and Taufic: Closure of atrial septal defects with the aid of hypothermia. in Surgery



Sept. 2nd 1952. The first open heart surgery, 2 cm ASD-II closure in a 5 year old girl, $t=26^{\circ}\text{C}$ full body hypothermia, with inflow stasis. (University of Minnesota Hospital)

„Cross-circulation”



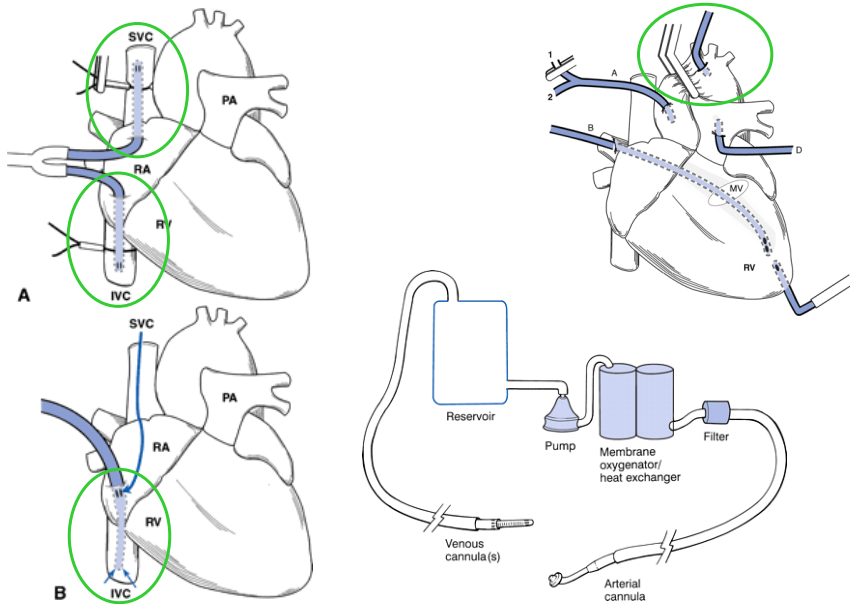
CW Lillehei (1919-1999)

Lillehei-Cohen-Warden

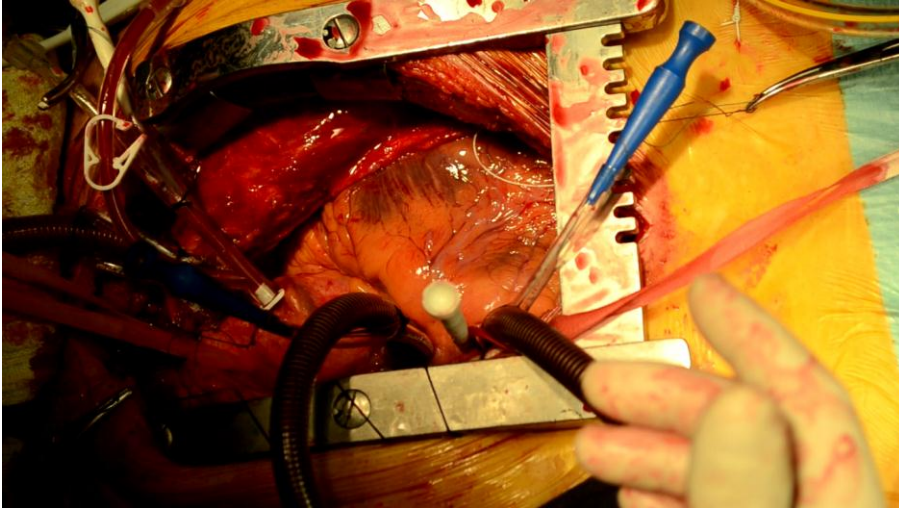
Hard criticism...

1954-55: 45 open heart surgeries: VSD, AV-canal, Fallot-IV. Eg.: F-IV 14 minutes cross-circulation time.

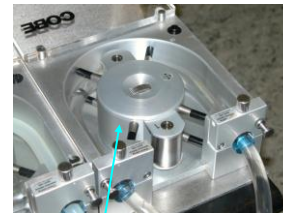
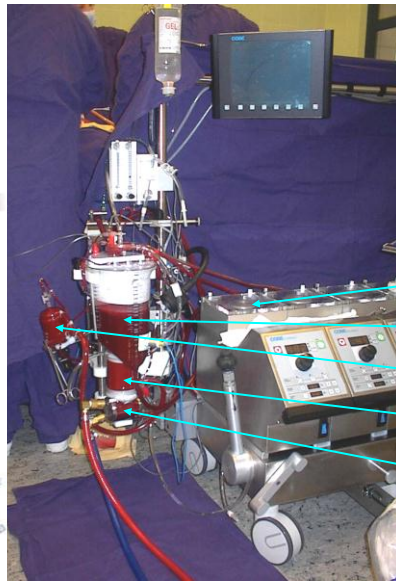
The schematic of extracorporeal circulation



The cannulation in real life



The modern heart-lung machine

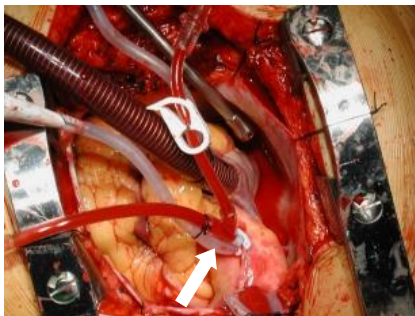


- roller pump (2)*
- reservoir (1)*
- bubble trap (5)*
- oxygenator (3)*
- heat exchanger (4)*
- tubing*

The pathophysiology of the ECC

- *hemodilution*
- *locoregional malperfusion*
- *acidosis*
- *inflammatory response, complement activation*
- *capillary leakage*
- *actions of hypothermia (Hb oxygen binding properties, enzyme activity, hemostasis, etc.)*
- *disruption of blood cells*
- *metabolic, endocrine changes*
- *electrolyte disturbances*

Myocardial protection



*anterograde aortic root
cardioplegia and vent*



local ice-squash

Myocardial protection by administering a special cold solution into the coronary circulation. The most popular: +4 °C hyperkalaemic crystalloid cardioplegia, that causes depolarization block, arrest, sparing the energy expenditure of contraction and electric activity.

Myocardial protection

anterograde

aortic root
direct ostial

retrograde

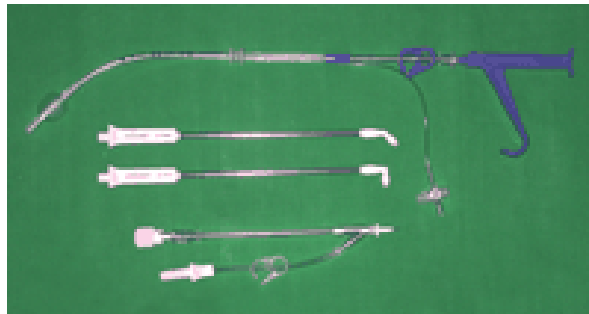
sinus coronarius

anterograde-

-retrograde

crystalloid - blood

cold - warm cardioplegia



The diagnosis of heart diseases

History: angina, dyspnea, fatigue

Physical changes: primarily not present in CAD, murmurs

Tests: ECG, stress ECG, Holter (silent ischaemia)

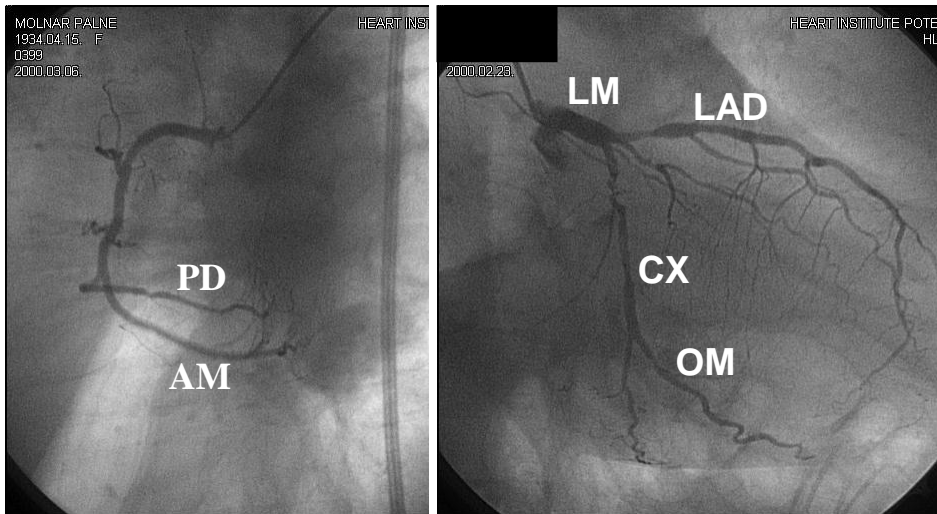
Echocardiography

Myocardium perfusion (heart light study):
scintigraphy, SPECT

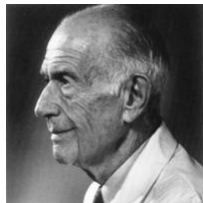
Coronary angio: above 40 years before any cardiac surgery
Coronary CT (or at suspicion of IHD)

Viability examinations: MRI, PET
Biopsy

Coronary angiography



Milestones of coronary surgery



Arthur M. Vineberg (1903–1988)

1950. First human Vineberg-operation

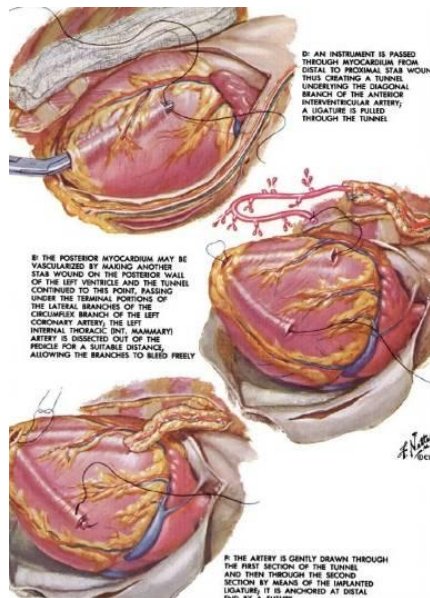
Vineberg Graft: Flow Reserve of Bilateral Implantation After 27 Years

Roger Marx, MD, Thomas W. Jax, MD, Malte Kelm, MD, Frank C. Schoebel, MD, and Bodo E. Strauer, MD

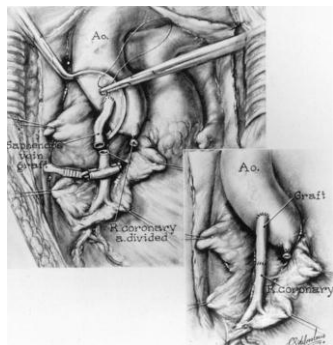
Department of Cardiology, Pneumology, and Angiology,
Heinrich Heine University Düsseldorf, Düsseldorf, Germany

We report a patient who underwent bilateral internal thoracic artery implantation into the myocardium known as a Vineberg procedure 27 years ago. Coronary angiography and Doppler echocardiography revealed patent grafts with total occlusion of all native coronary arteries. We measured flow velocities at rest and under stress conditions with noninvasive ultrasonic Doppler echocardiography. The flow patterns in both grafts were biphasic as in native coronary arteries. Under stress conditions no increase in flow was detectable as a marker of end-stage coronary artery disease with refractory angina pectoris.

(Ann Thorac Surg 2001;71:341–3)



Milestones of coronary surgery



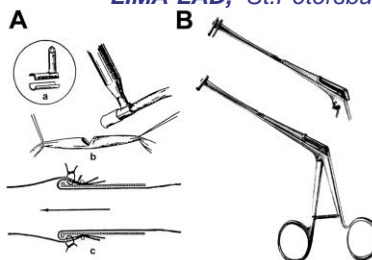
David Sabiston
(1924-2009)



Vasillij I. Kolesov
(1904-1992)

February 25th 1964. First
LIMA-LAD, St.Petersburg

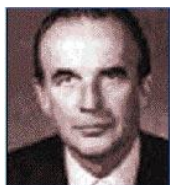
The first human saphenous vein–coronary artery bypass, performed by David Sabiston, Jr, in 1962. The vein autograft was anastomosed end-to-side from the ascending aorta (Ao) and end-to-end to the distal right coronary artery; the proximal, cut end of the artery has been ligated.



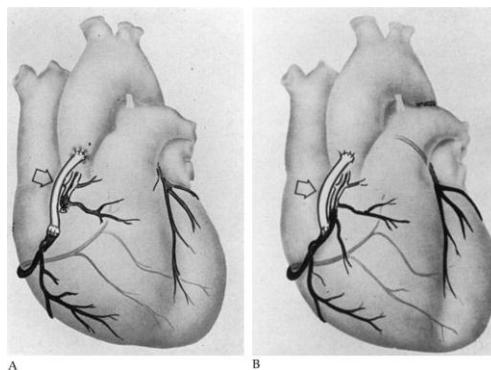
Milestones of coronary surgery



René Gerónimo Favaloro
(1923-2000)

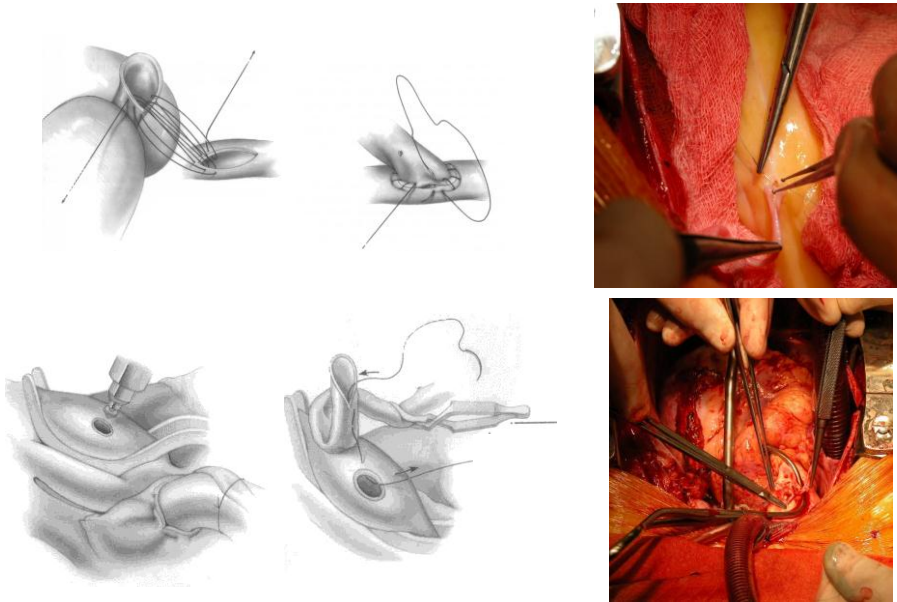


Donald Effler (1915-2004)

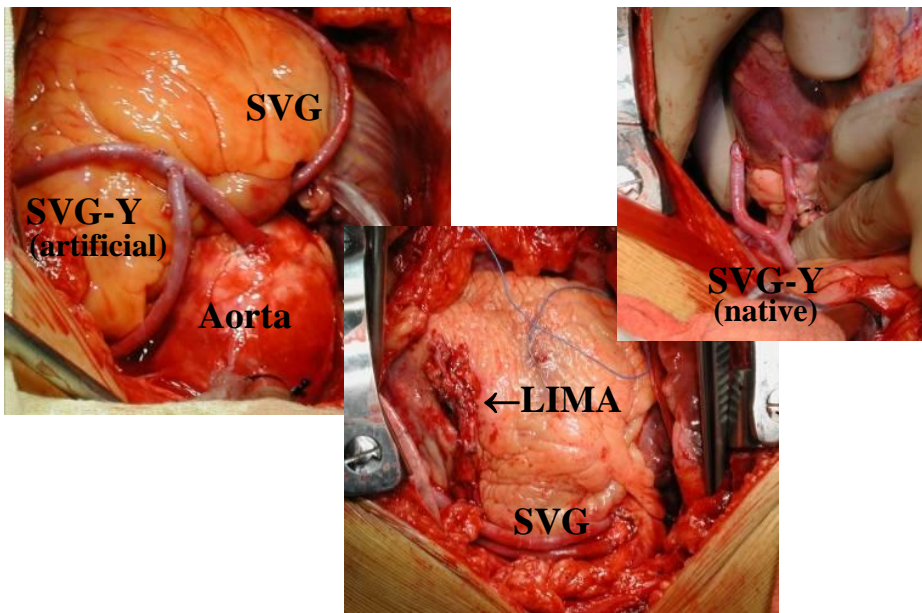


The saphenous vein bypass graft operations performed on the right coronary artery by Rene Favaloro and Donald Effler, beginning in May 1967. (A) Aortocoronary bypass graft, end-to-end distal anastomosis. (B) Aortocoronary bypass graft, end-to-side distal anastomosis.

Surgical technique: distal and proximal anastomosis

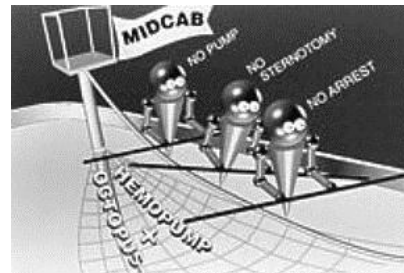


Coronary surgery: before the pericardium closure



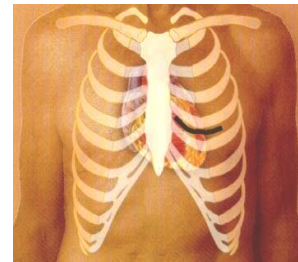
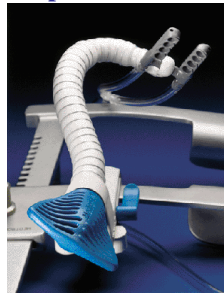
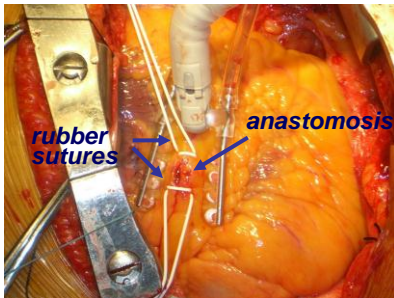
Coronary surgery: minimally invasive directions

„off-pump” CABG MIDCAB

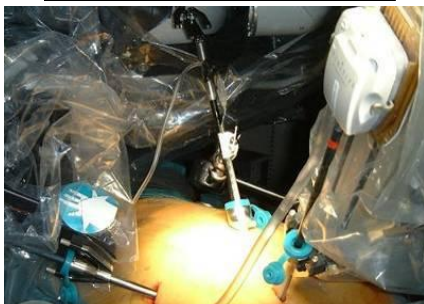
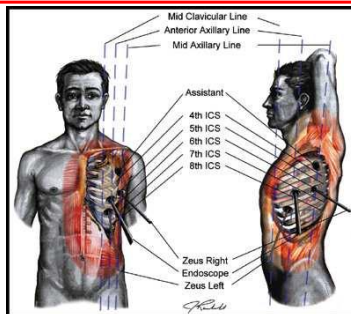


Stabilizing LAD

Octopus, Medtronic, Inc.



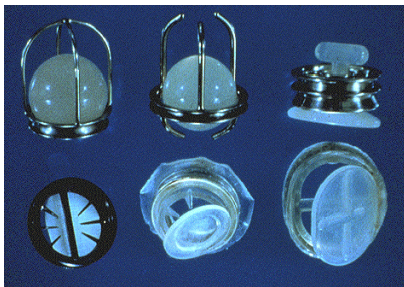
Endoscopic robot-assisted CABG



Zeus surgical robot

Milestones of valvular surgery

Commissurotom, Souttar, 1925.



Bi-leaflet

Tilting disc

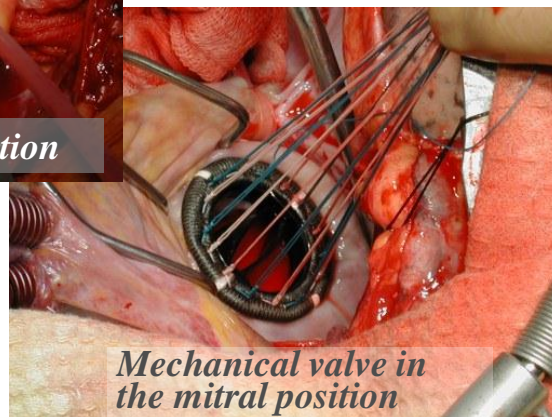
Biograft



Intraoperative views



Biograft in aortic position



Mechanical valve in the mitral position

Preoperative examinations, preparation

- investigating cardiac status, stabilizing patient
- above 40 years coronary angiography
- screening and treating foci
(dental, ENT, urology/gynecology)
- chest X-ray, abdominal ultrasound
- carotid Doppler or carotid angiography
- specialist at any comorbidity or suspicion! (vascular surgeon, colonoscopy, gastroscopy, endocrinology, etc.)
- **discontinuing oral anticoag., anti-TCT, metformin**

Follow-up for CABG

Before discharge screening for ASA efficiency by thrombocyte aggregometry (TAG), adding clopidogrel if necessary, LMWH

Cardiac surgery control at 6-8 weeks: complaints, wound healing, sternum stability, ECG, Echocardiography

Cardiology control every 6 months or annually (ECG, stress test, Echocardiography), on demand interventional or cardiac surgical control, see family physician

Anti-platelet drugs life-long, if should be stopped before any intervention → administer LMWH

Secondary prevention: lifestyle, diet, drugs (statin, anti-TCT, β -blocker, etc.)

Patient follow-up after valve op.

Anticoagulation: Syncumar/Cumadine to INR
Biograft: 3-6 months (INR 2.0-3.0), now ASA+clopi
Mechanical: life-long (Ao: 2.0-3.0, M: 2.5-3.5)
Tell it before any medical intervention !
1 week before any operation change to LMWH
postoperatively heparine for some days

Endocarditis profilaxis: antibiotics
In case of dental extraction (deperation) or before
and after any invasive intervention
amoxicillin+clavulanic acid, erythromycin

Thank you for your attention !

