Cardiac surgery – Introduction

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http://aok.pte.hu/en/egyseg/oktatasianyagok/290

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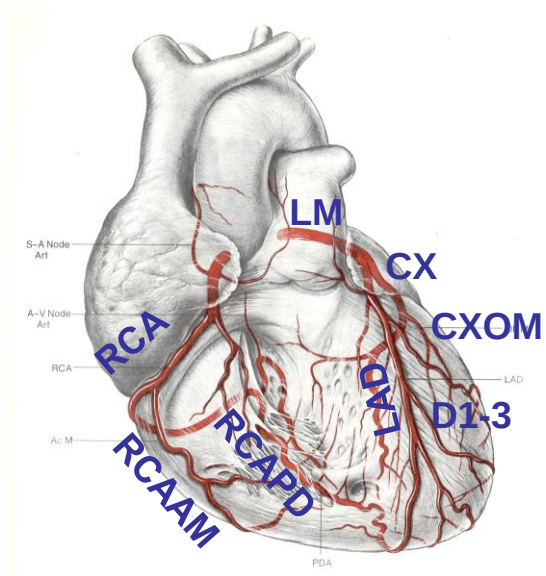
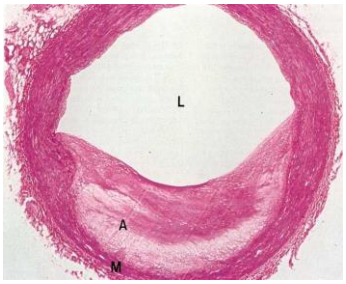
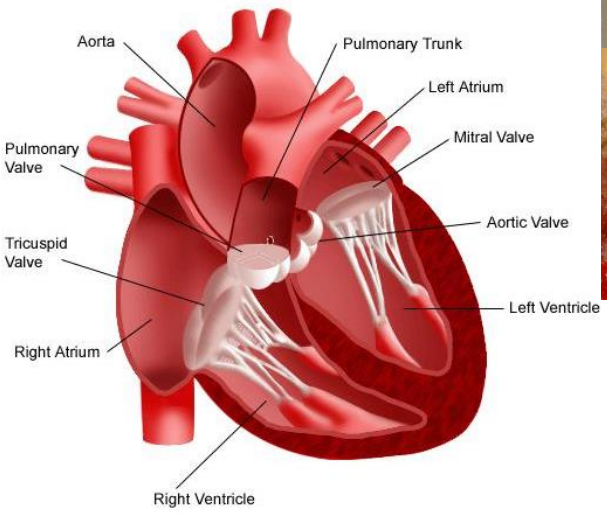
The anatomy of coronary arteries





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**

<u>combined operations</u> (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**

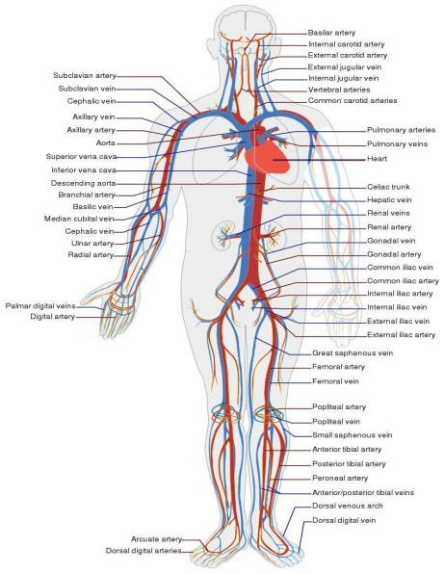
The requirements for modern cardiac surgery

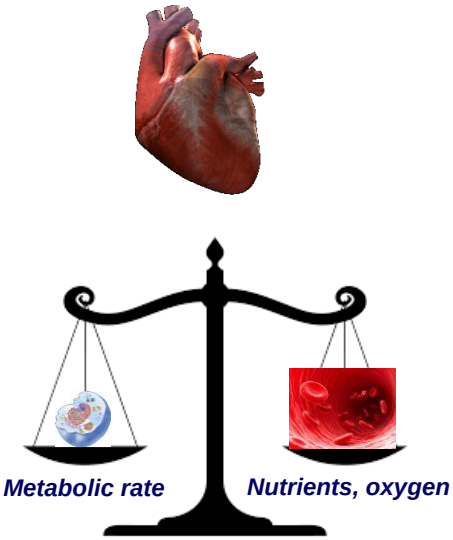
- **diagnostic background (coronarography, echo)**
- **asepsis, antibiotics**
- **transfusiology**
- **hemostaseology**
- **anesthesiology - intensive care**
- **extracorporal circulation**
- **myocardium protection**
- **operative technique**
- **artificial valves, other prostheses**

Milestones in cardiac surgery

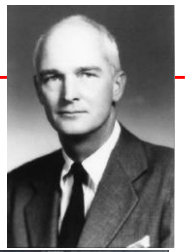
1896. Rehn (G, 1849-1930) successfully sutures a heart wound
1925. Souttar (UK, 1875-1964) – closed mitral commissurotomy
1928. Forssmann (G, 1904-1979) – first cardiac catheterization via cephalic vein on himself
1939. Gross (USA, 1905-1988) – ligature of ductus Botalli
1950-s Gibbon, Kirklin, Lillehei - 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



John Gibbon (1903-1973)

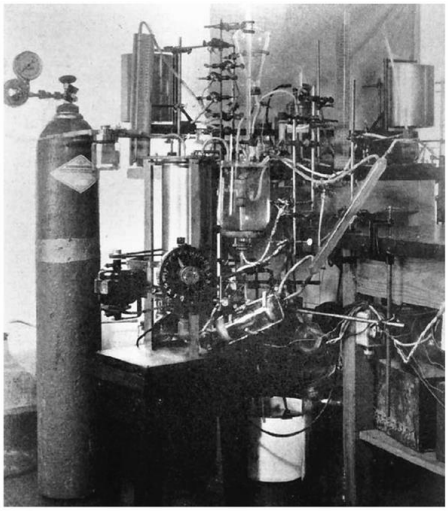
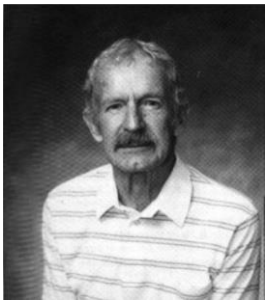


Fig 2. Photograph taken in Dr Gibbon's laboratory, showing an early version of his heart-lung machine. (Courtesy of J. H. Gibbon, Jr. Reprinted with permission from Gibbon JH et al. Arch Surg 1937; 34:1109.)

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

Hypothermia – other arm of the scale

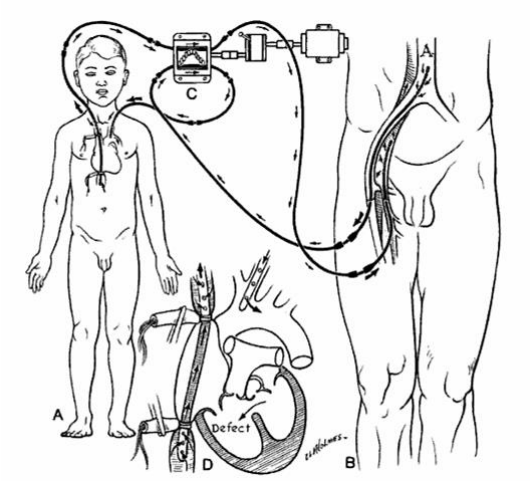


JF Lewis (1916-1993)

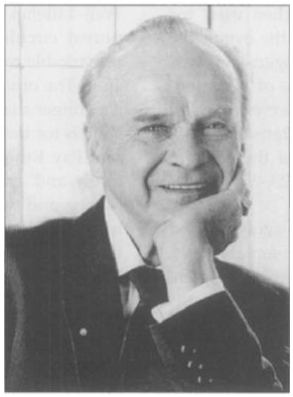
***1953.** Lewis and Taufic: Closure of atrial septal defects with the aid of hypothermia. in Surgery*

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

„Cross-circulation”



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

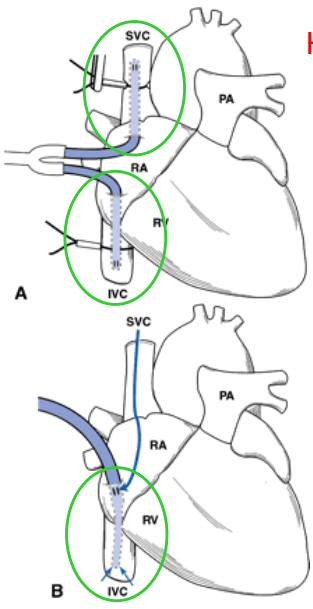


CW Lillehei (1919-1999)

Lillehei-Cohen-Warden

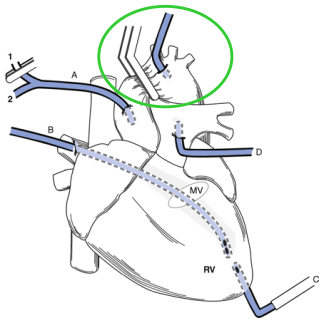
Hard criticism…

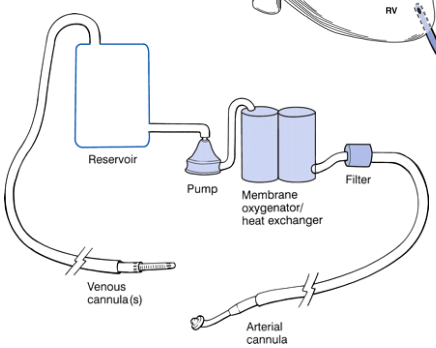
The schematic of extracorporeal circulation



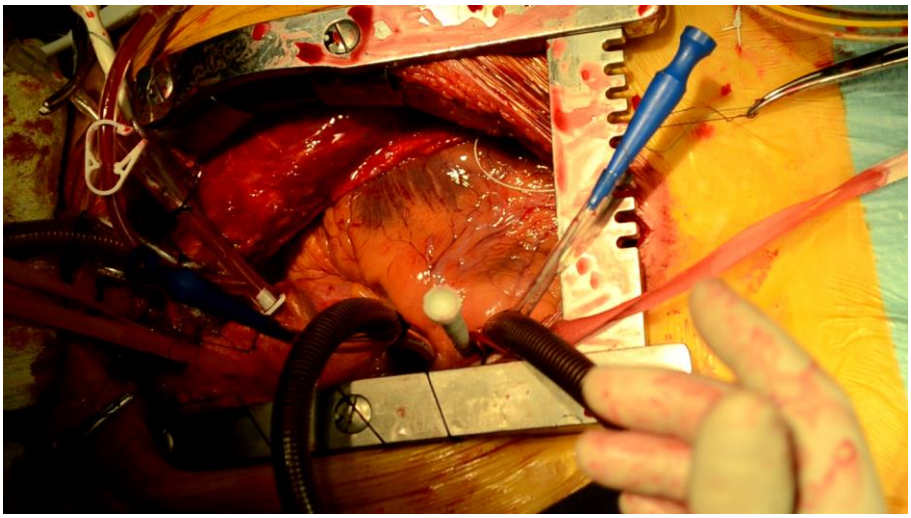
Heparinization:
300IU/bwtkg
Na-heparin

Antidote:
Prothamin

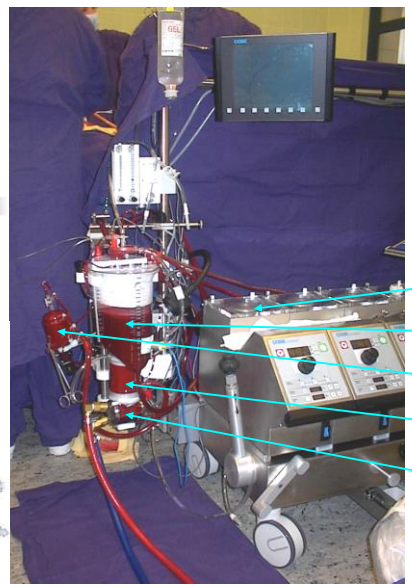




The cannulation in real life



The modern heart-lung machine



roller pump (2)

reservoir (1)

bubble trap (5)

oxygenator (3)

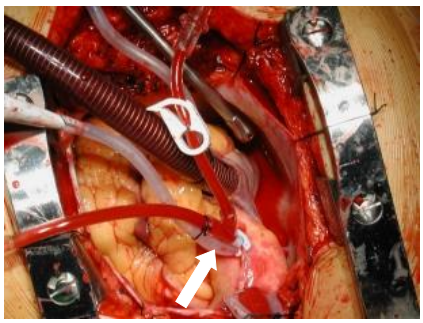
heat exchanger (4)

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. **<u>The most popular:</u> +4 °C hyperkalaemic crystalloid cardioplegia, that causes depolarization block, arrest, sparing the energy expenditure of contraction and electric activity.**

Myocardial protection

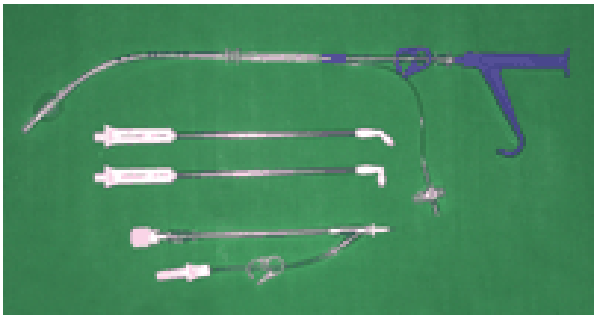
anterograde
aortic root
direct ostial

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 (transthoracal, transesophageal)

(Myocardium perfusion: scintigraphy, SPECT)

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

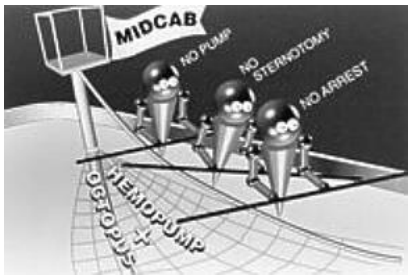
Viability examinations: MRI, (PET)
Biopsy

Possible complications of heart operations

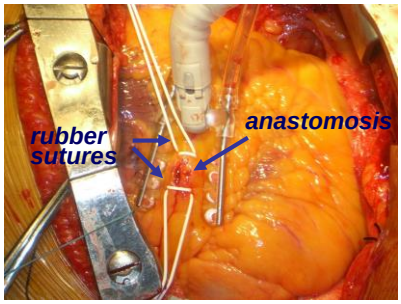
- injury at cannulation site
- thromboembolism (heart, brain, kidney, extremity...)
- bleeding, coagulopathy, DIC
- pleural, pericardial effusion (Dressler)
- perioperative infarction, heart failure
- arrhythmia (atrial fibrillation, VES, stb.)
- phrenic nerve palsy (due to ice squash)
- airway infection, atelectasis, pneumonia
- neurological, mental distrurbances
- stress ulcer, gastrointestinal hemorrhage
- wundhealing problem, infection, septicaemia
- exacerbation of unrecognized infectious focus
- dissemination of unrecognized tumor
- exitus lethalis

Minimally (less) invasive directions

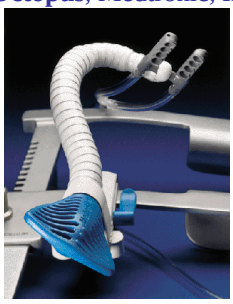
„off-pump" CABG
MIDCAB

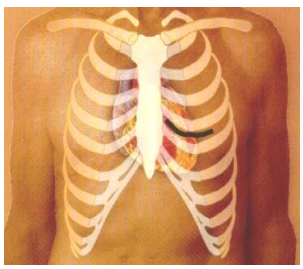


Stabilizing LAD



Octopus, Medtronic, Inc.





Off-pump CABG operations

- ➢ avoids complications of ECC
- ➢ however, hypoperfusion↑
- ➢ still manipulations on asc. aorta

- need for special stabilizing device
- occluder or shunt occluder
- sometimes difficult access of coron.
- cannot open heart chamber
- operative manipulation affects cardiac output

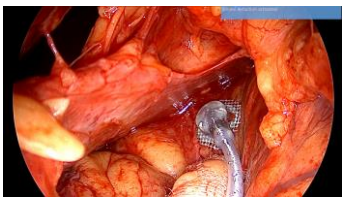
Minimally invasive access

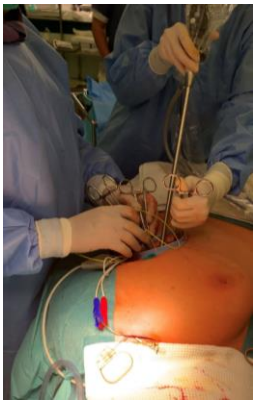
- smaller (even 4-6 cm!) skin incision
- minimal tissue damage, intact chest wall

- less operative stress
- shorter operation (?)
- less complications (?)
- less postop. pain
- shorter physical recovery
- early rehabilitation
- better cosmetical results
- reduced costs (?)

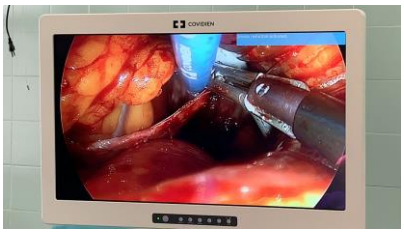
Minimally invasive access: VATS

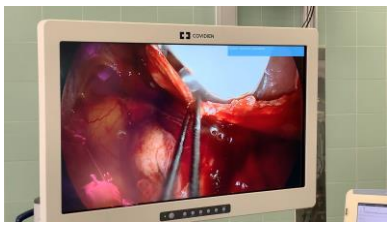
- through10mm ports
- through uniport access

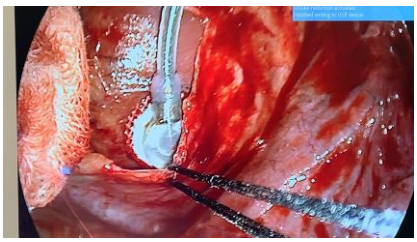




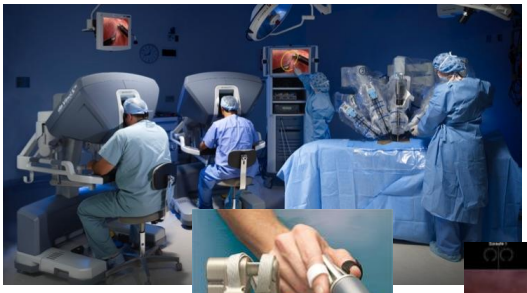
Minimally invasive access: epicard. PM

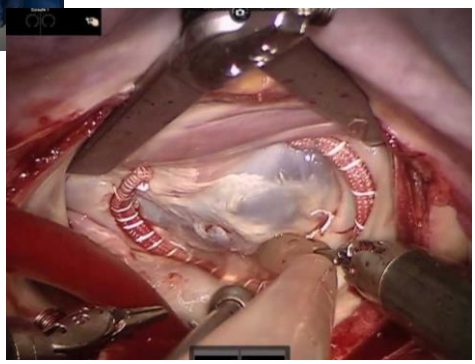






Robot-assisted surgery





- Mitral valve repair
- CABG
- PM electrode implant.
- etc.

Thank you for your attention !