



Petr Fila

CARDIAC SURGERY

- general principles
- congenital heart disease
- ischemic heart disease



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Cardiac surgery history

- 1896 - heart stab wound suture (Rehn)
- 1923 - „close path“ mitral stenosis operation (Cutler,Levine)
- 1925 - comisurolysis of mitral valve through LA appendage (Souttar)
- 1938 - open arterial duct ligation (Gross)
- 1944 - Blalock-Taussig shunt in tetralogy of Fallot
- 1944 - surgery for coarctation of the aorta – resection (Crafoord)
- 1953 - atrial septal defect closure – hypothermia (Lewis)
- 1953 - EXTRACORPOREAL CIRCULATION – ASD closure (Gibbon)
- 1955 - surgery for tetralogy of Fallot (Kirklin)
- 1960 - aortic valve replacement (Harken)
- 1960 - mitral valve replacement (Starr)
- 1962 - heart revascularization with vein grafts
- 1964 - heart revascularization with LITA
- 1967 - heart transplantation
- 1967 - artificial heart (Cooley)



Cardiac surgery in hypothermia

First open heart surgery in hypothermia –
ASD closure (Navrátil , Brno 1956)



Surgical approaches in cardiac surgery

Median sternotomy

Ministernotomy (aortic valve, ...)

Thoracotomy

- right side (ASD, Mi, Tri, re-do surgery)
- left side (open arterial duct, CoA, decs. aorta)

Minithoracotomy

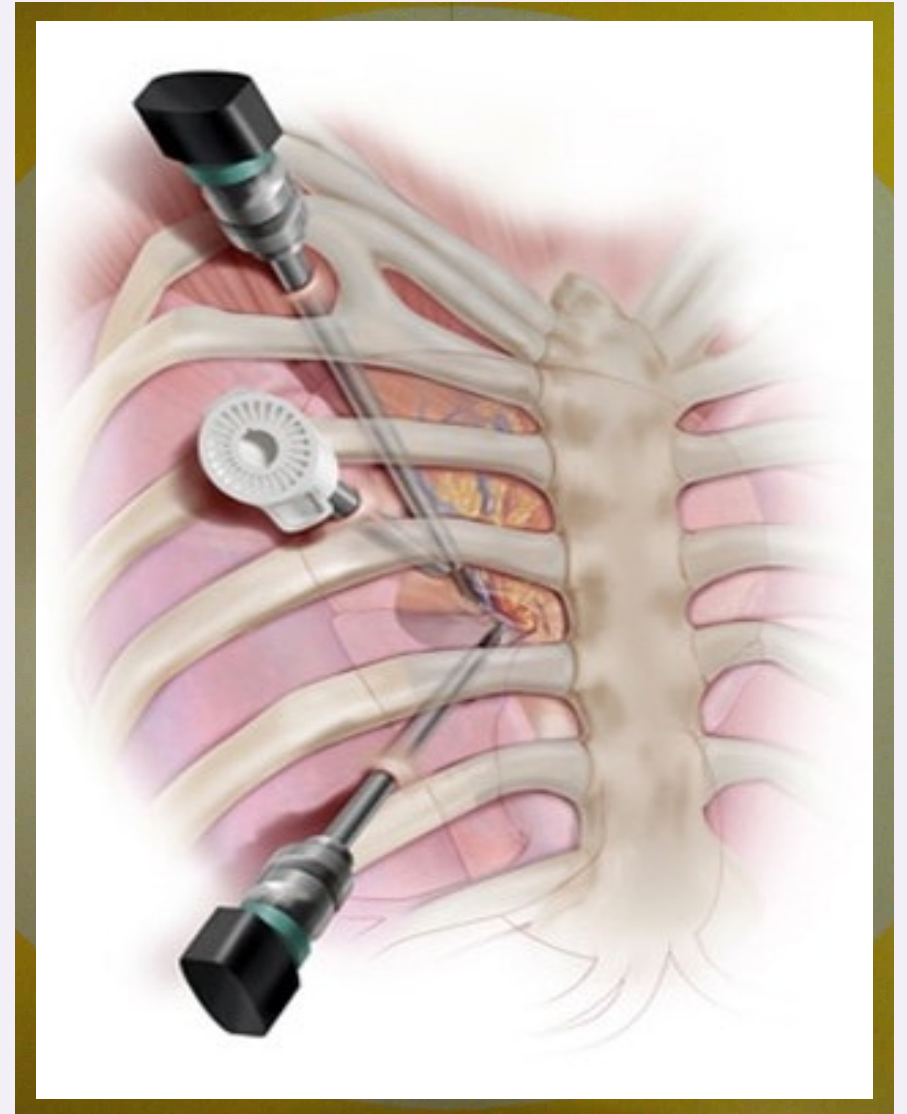
- left side – ischemic heart disease, open arterial duct)
- right side (IHD)

Transverse sternotomy

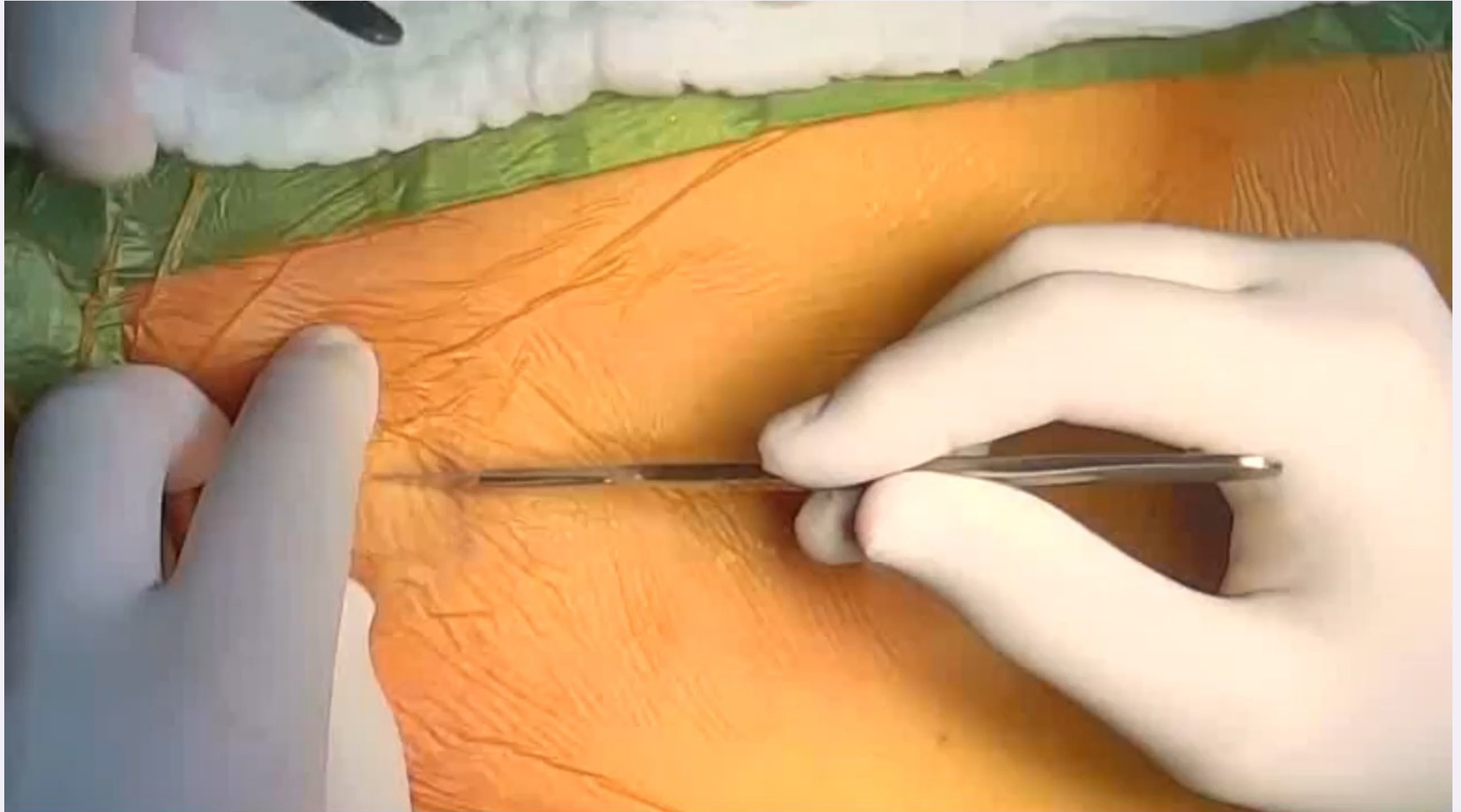
Parasternal incision

Incision in the epigastrium

Endoscopic approach (robotic)



Ministernotomy



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Cardiac surgery

- **without cardiopulmonary bypass - beating heart**
 - congenital heart diseases (open arterial duct, CoA)
 - CABG
 - pericarditis
 - heart injury
 - mitral commissurotomy
- **with cardiopulmonary bypass (ECC)**



Extracorporeal circulation – cardiopulmonary bypass

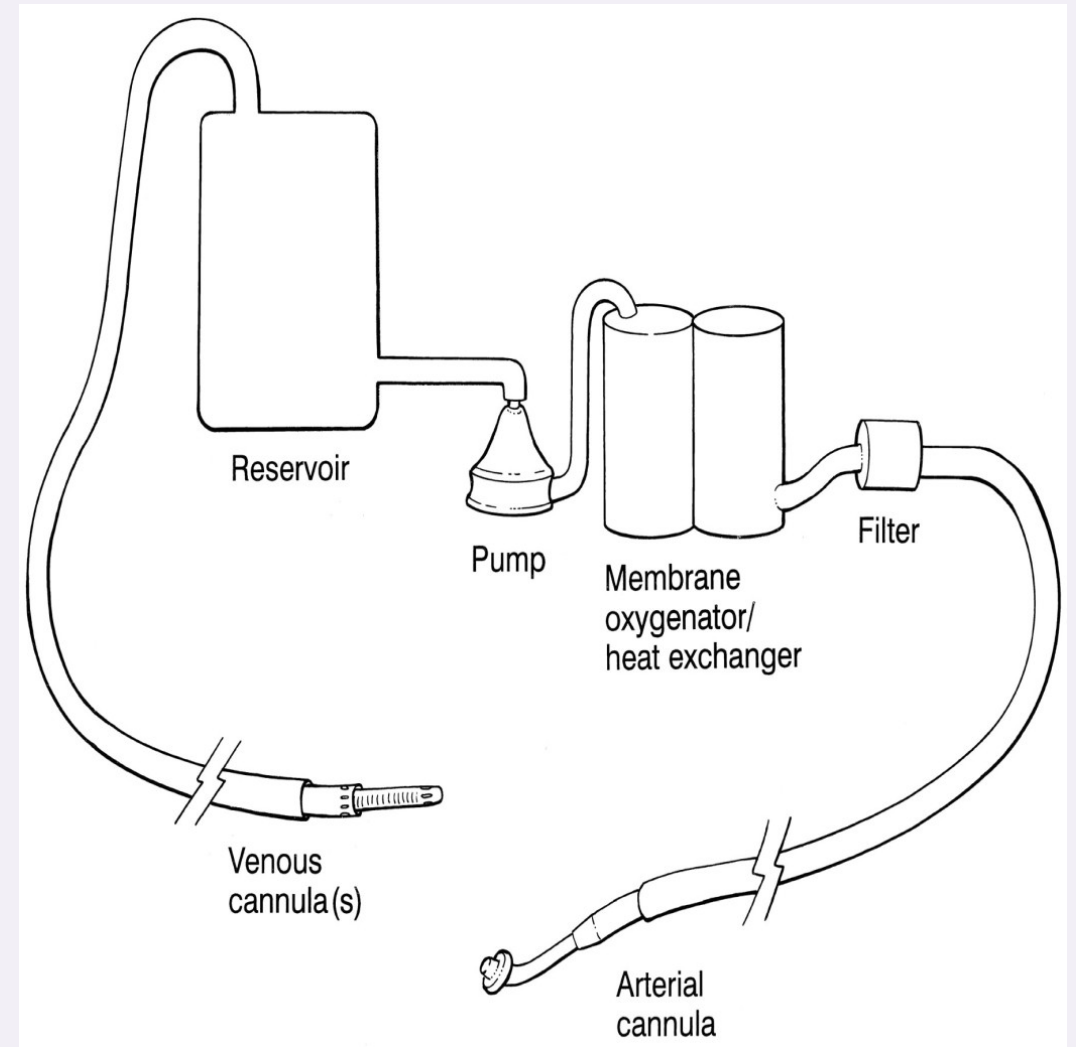
1. Pump

2. Oxygenator

3. Heat exchanger

Principles

- heparinization (2-3 mg/kg)
- hemodilution
- hypothermia
normothermia



Extracorporeal circulation



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First ECC in central Europe

Brno, 1958



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Extracorporeal circulation nowadays



Myocardial protection

Ischemic cardiac arrest = myocyt injury

Cardioplegic solution
crystalloid x blood
warm x cold

Types of delivery
antegrade
retrograde



Heart disease

Congenital

- without shunting
- left to right shunt
- right to left shunt

Acquired

- ischemic heart diseases
- valve diseases
- aortic diseases
- tumors
- others



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Congenital heart disease

0,6-1% newborns

the most often - VSD, ASD, open arterial duct

Main principles of treatment

- critical defects - early repair**
- others – at the preschool-age surgery**

- radical correction**
- palliative surgery**



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Advance in congenital heart surgery

- fetal ECHO development, noninvasive diagnosis
- reduction of palliative surgery
- **radical correction during first step of surgery**
- catheter intervention techniques development
(BAS, ASD and VSD closure, PDA closure, coils, stents, dilation)
- post surgery mortality reduction, intensive care



Congenital heart disease

85% of CHD live to the age of adult

50% - absolutely healthy

25% - time to time observation
(possibility occurrence of residues)

25% - regular observation
if need - reintervention



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Congenital heart diseases - types

Congenital

- **without shunt**
- left to right shunt
- right to left shunt

coarctation of aorta
aortic arch disorders
aortic stenosis
pulmonary stenosis

Acquired

- ischemic heart diseases
- valve diseases
- aortic diseases
- tumors
- others



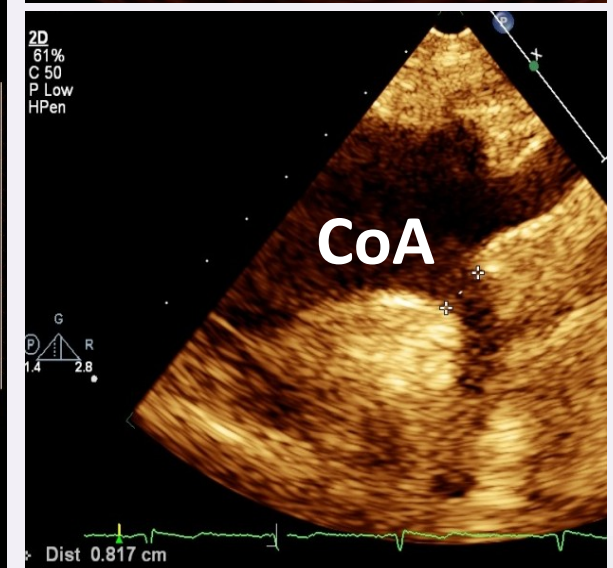
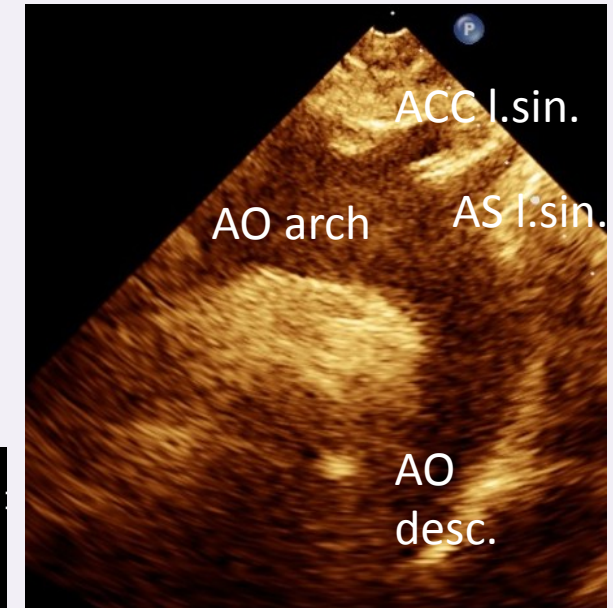
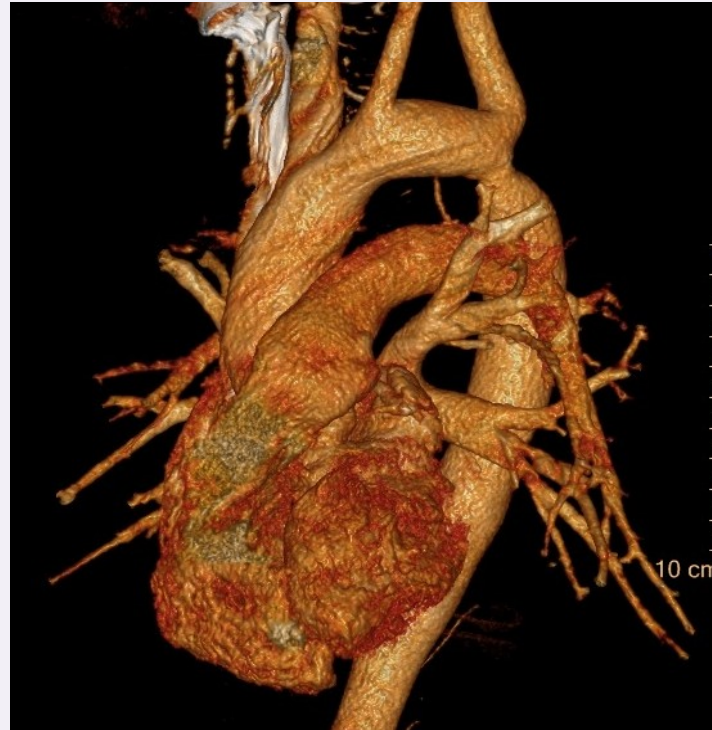
Coarctation of the aorta

5-8 % of CHD

male : female 2-5:1

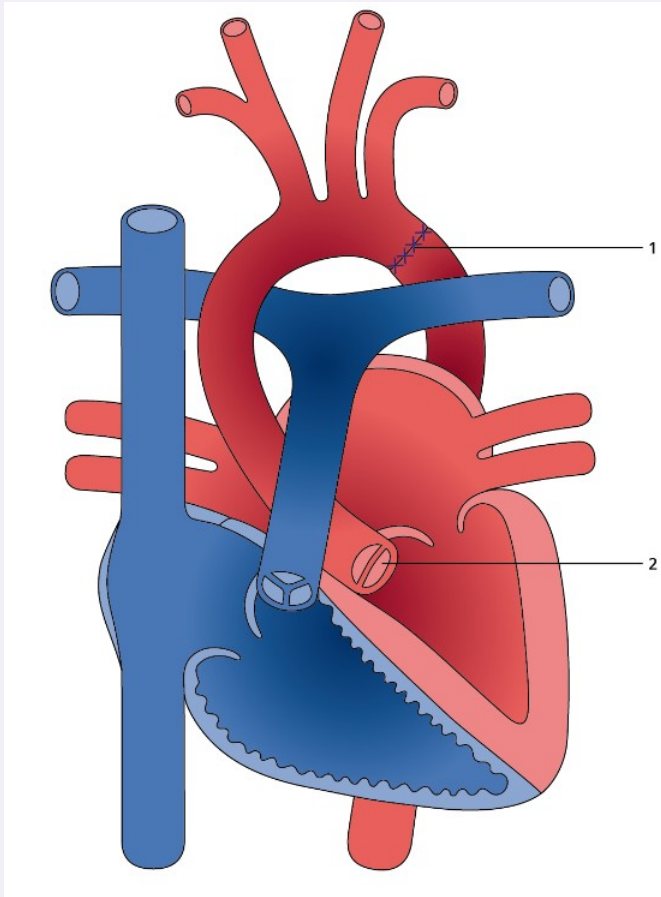
congenital narrowing of thoracic aorta after the origin of subclavian artery

- hypertensin in upper part of body

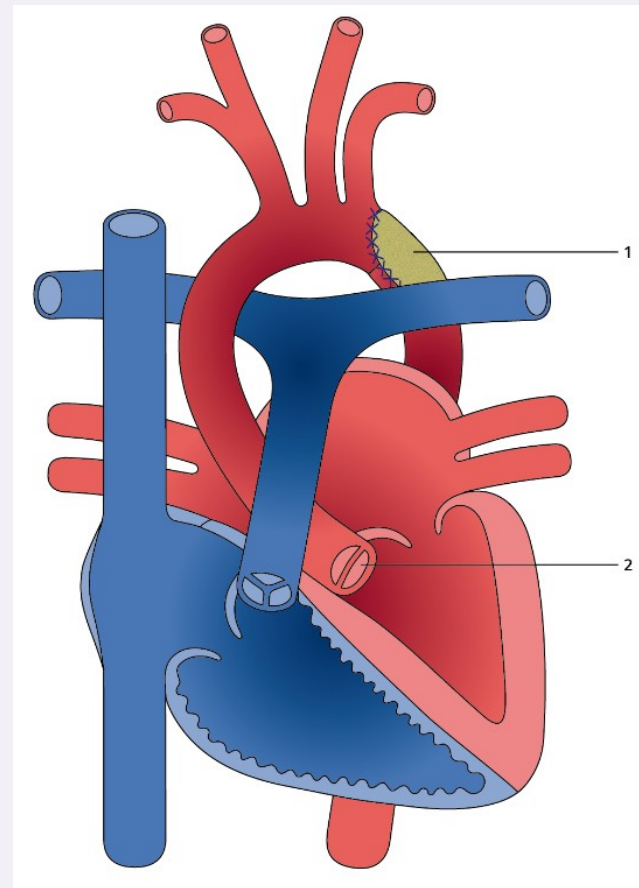


Coarctation of the aorta - surgery

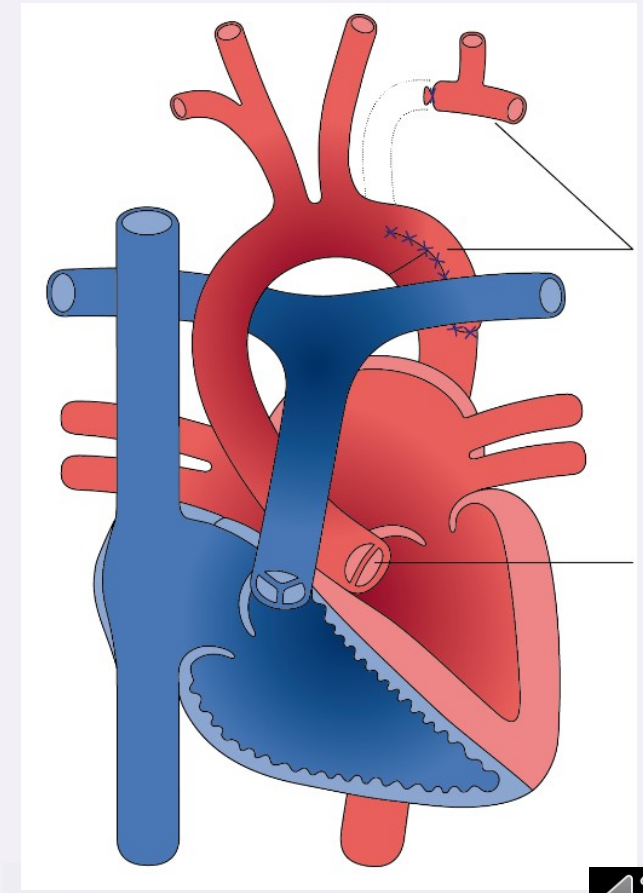
Resection + end to end anastomosis
(1945 C.Crafoord)



Reconstruction with patch - Vosschulte
(1957)

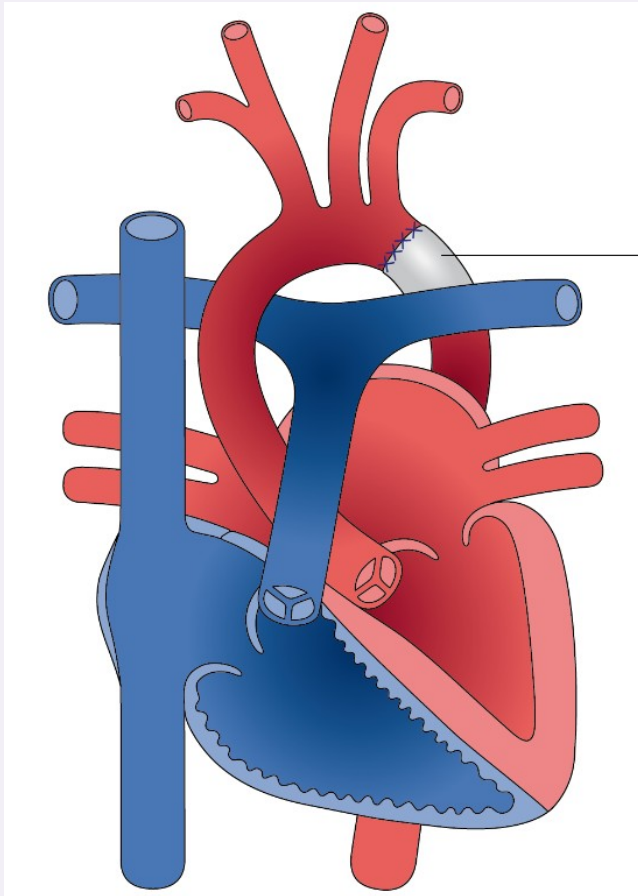


Reconstruction - Waldhausen (1966)

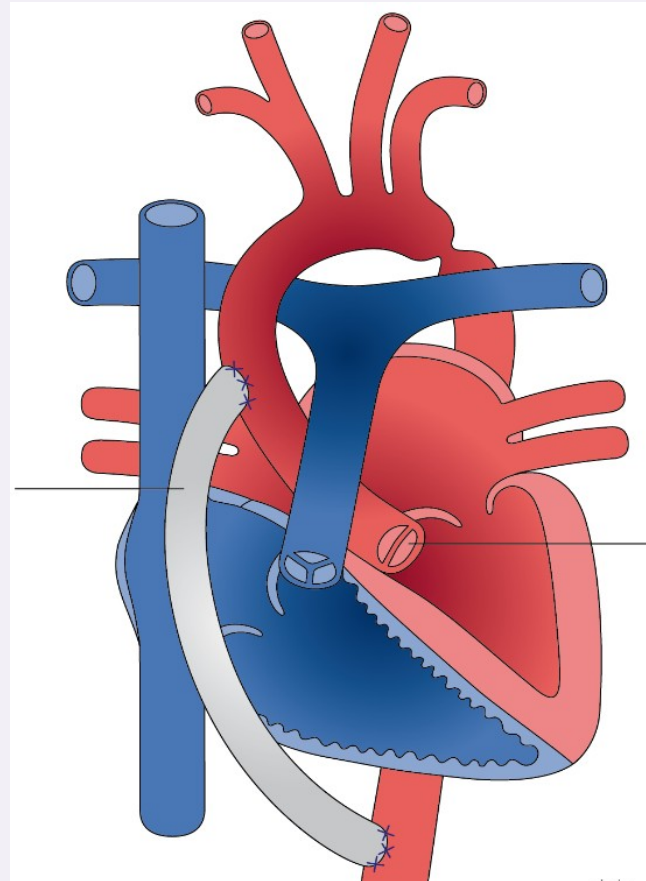


Coarctation of the aorta - surgery

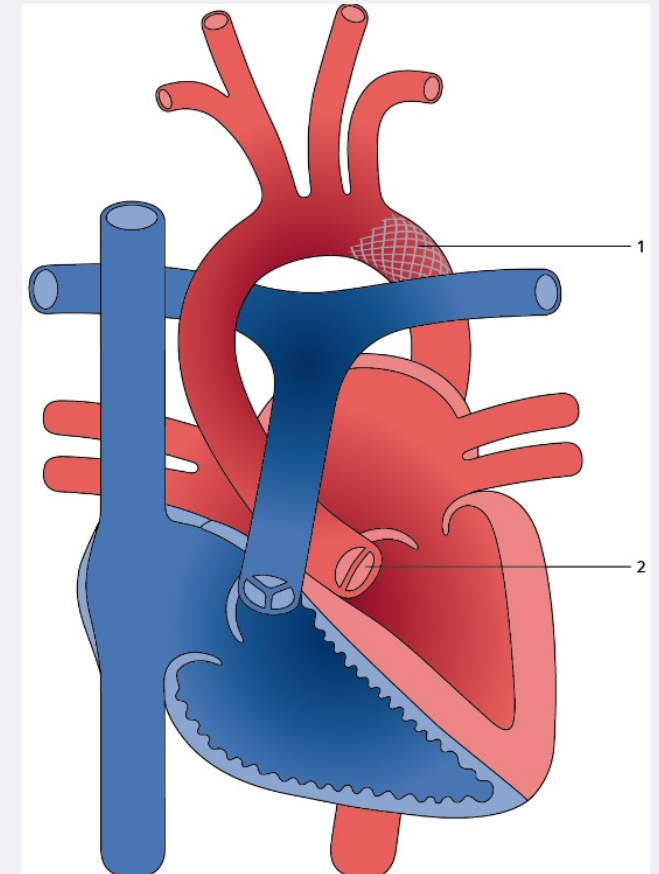
Excision + vascular prosthesis



Extraanatomic bypass



Stent/SG implantation



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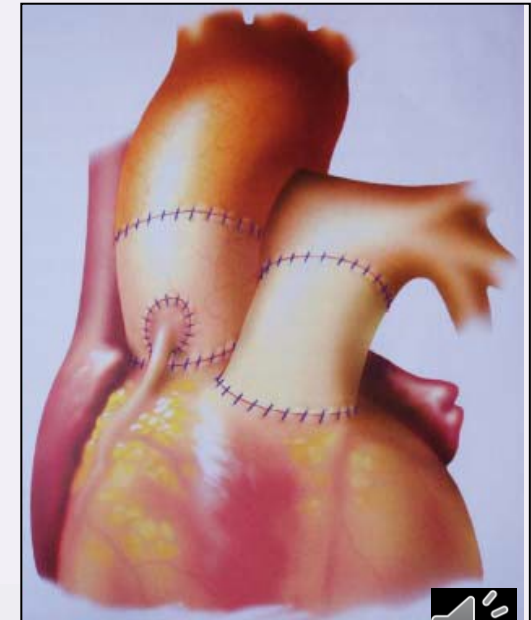
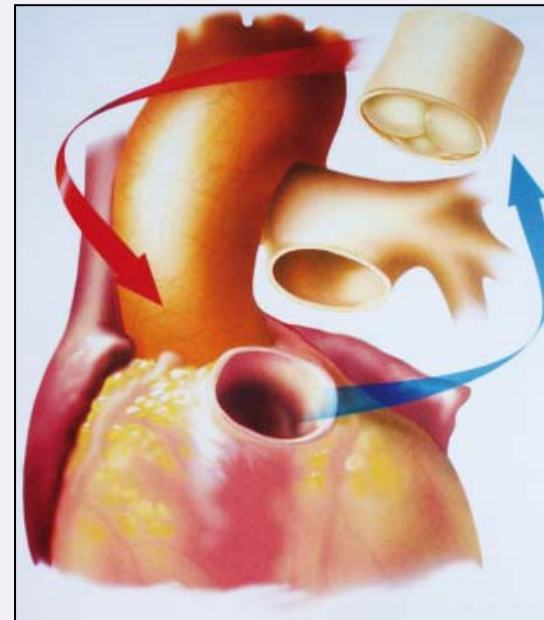
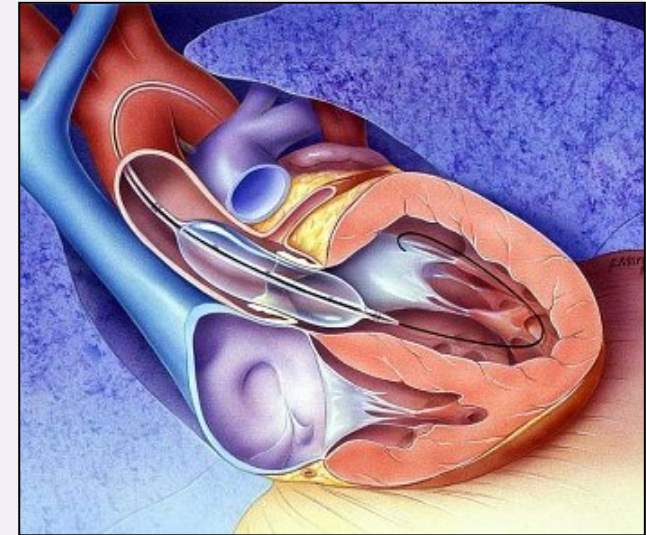


Congenital aortic valve stenosis

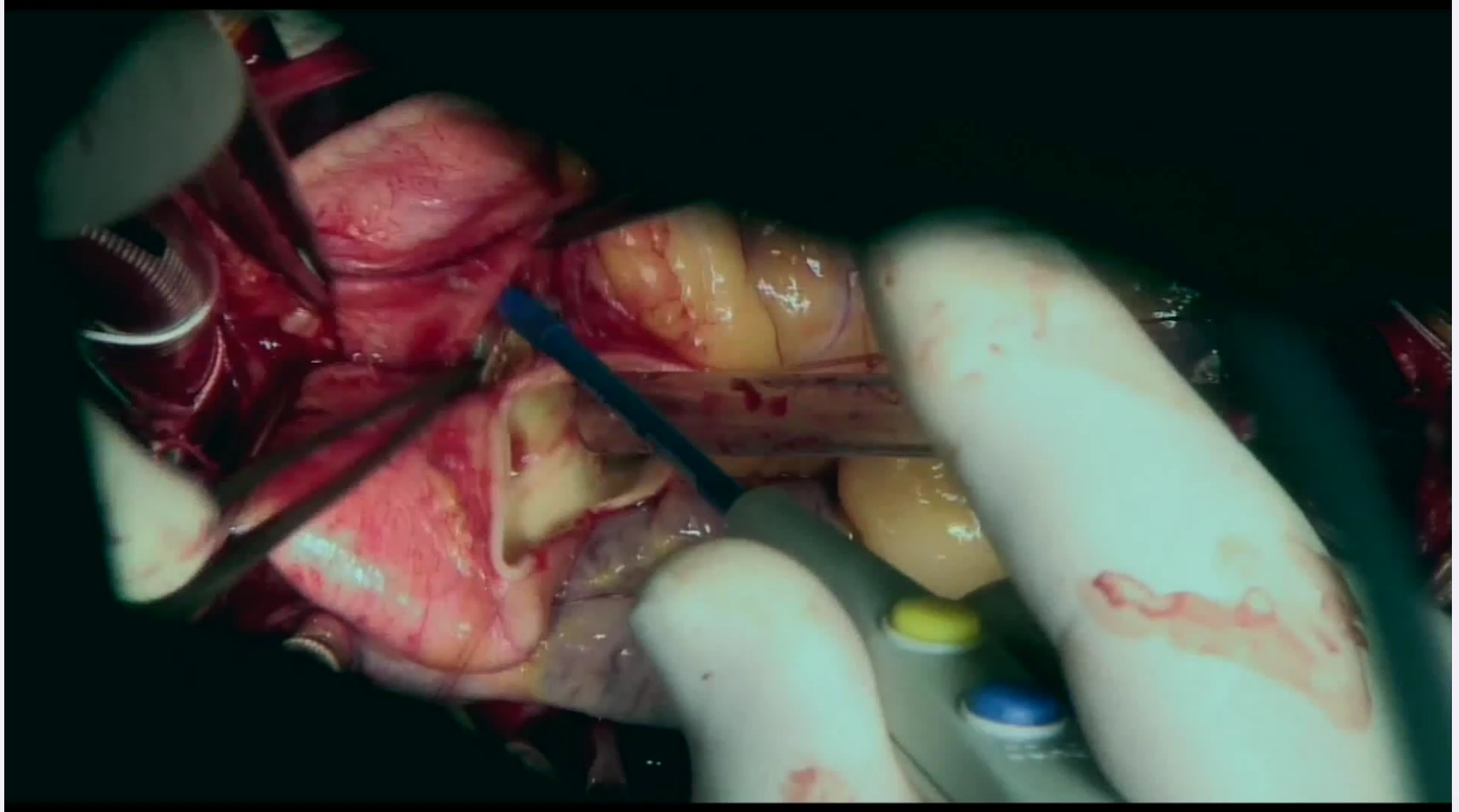
- subvalvular, valvular, supra- valvular
- palliative treatment
- reduction of surgery
- delaying of aortic valve replacement

Therapy:

- catheter treatment,
- aortic valve sparing surgery
- aortic valve replacement
mechanical (biological) valve
Ross procedure



Ross operation – autograft harvesting



Heart disease

Congenital

- without shunt

- **left-to-right shunt**

- right-to-left shunt

- **increased pulmonary blood flow**

- VSD

- ASD

- patent ductus arteriosus

- aortopulmonary window

- anomalous origin of the LCA from the pulmonary artery

- AV septal defect (incomplete x complete)

Acquired

- ischemic heart diseases

- valve diseases

- aortic diseases

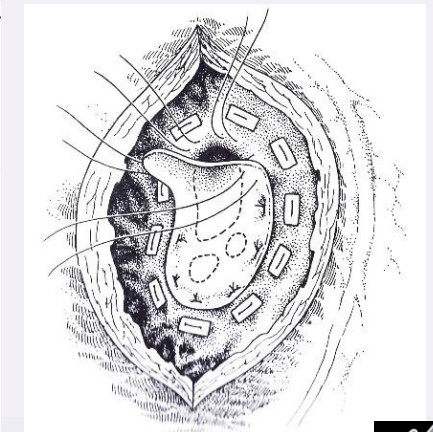
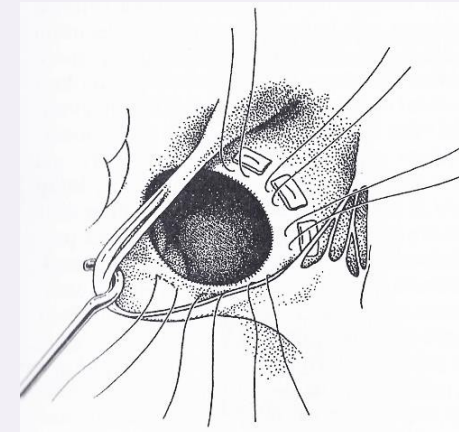
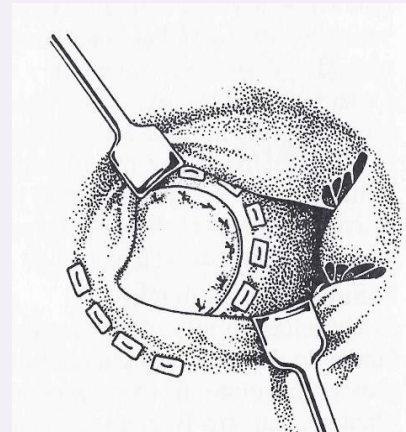
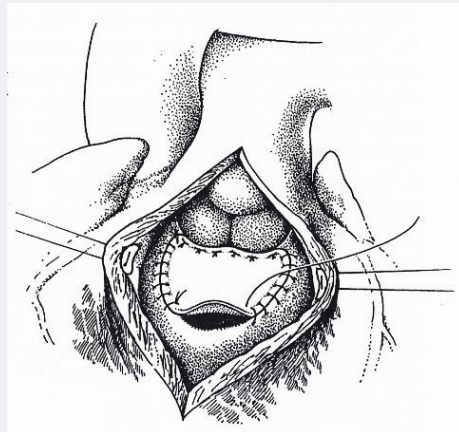
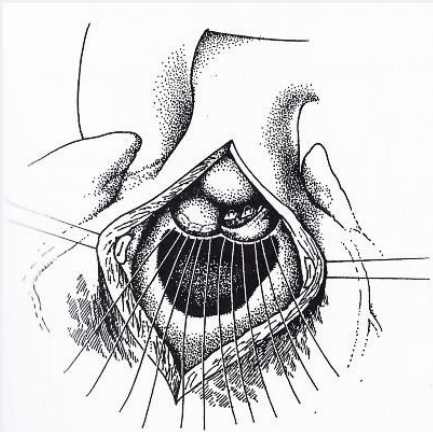
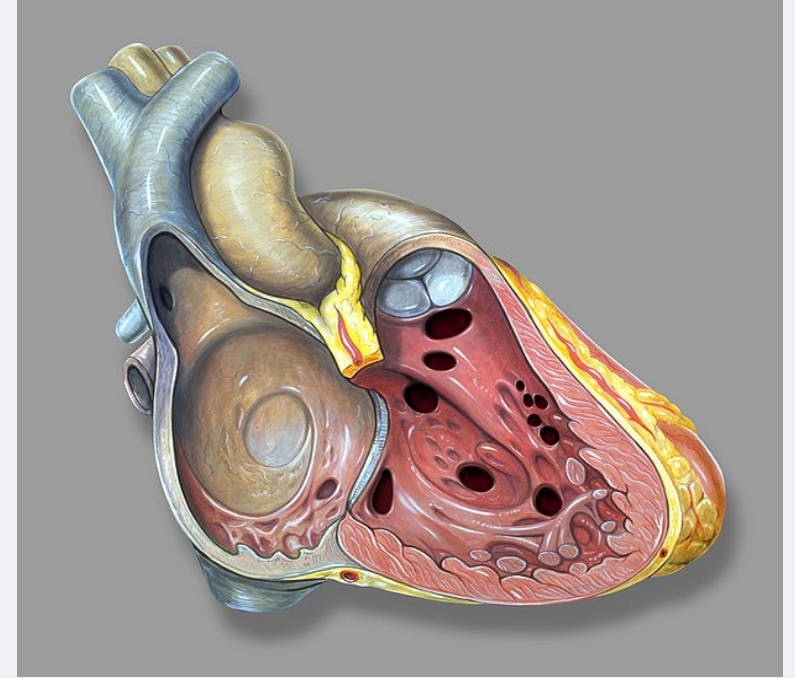
- tumors

- others



Ventricular septal defect

- most often CHD
- solated x with other CHD
- blood circulation pathophysiology depends on diameter and PVR



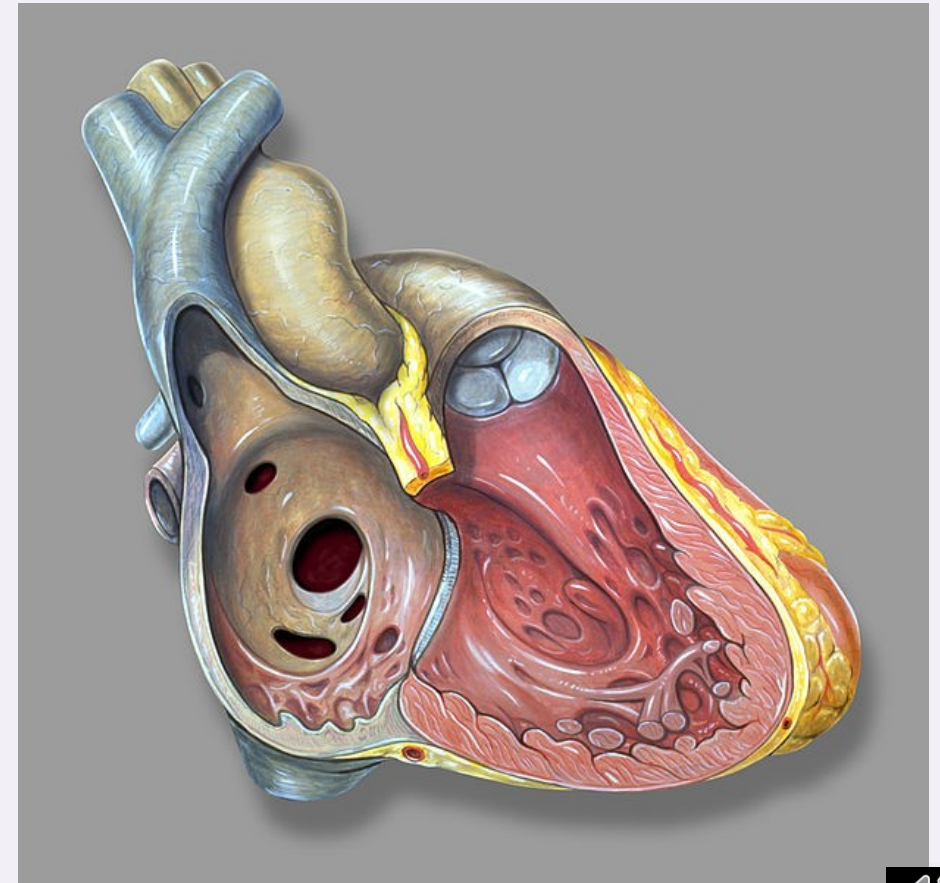
Atrial septal defect

no symptoms x large defect - weariness

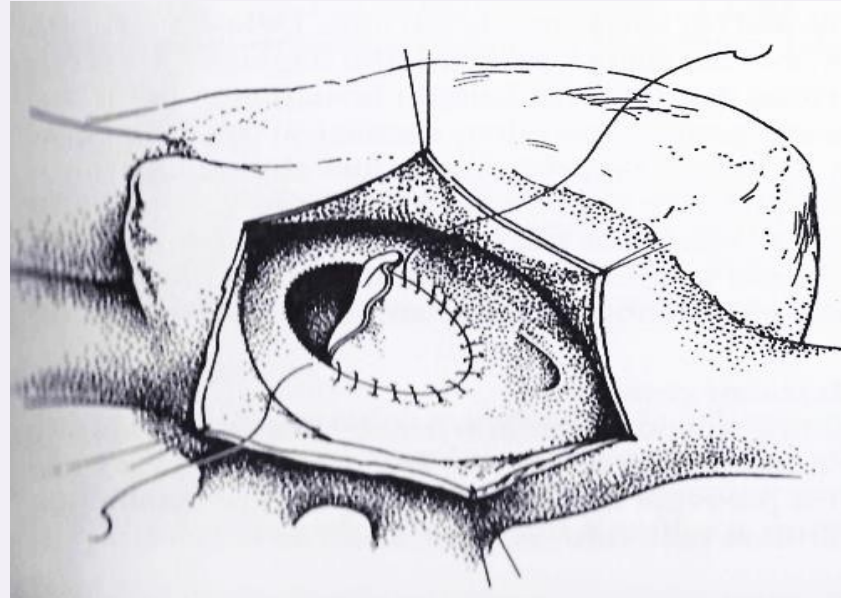
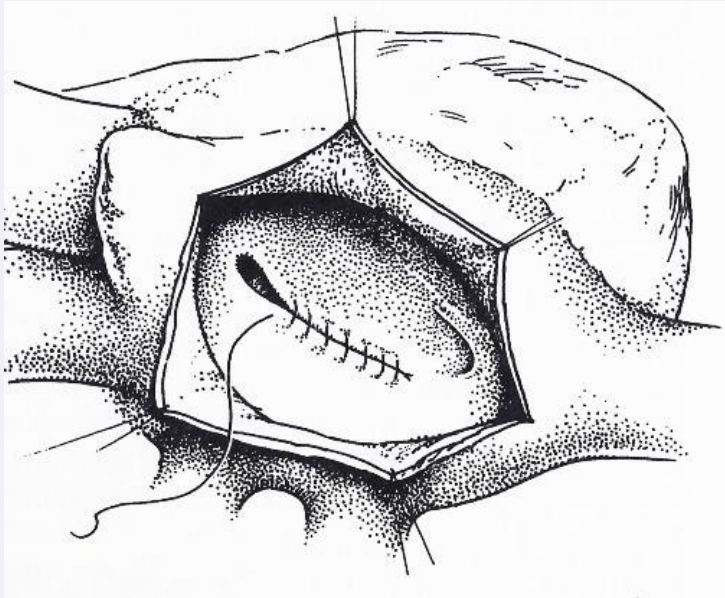
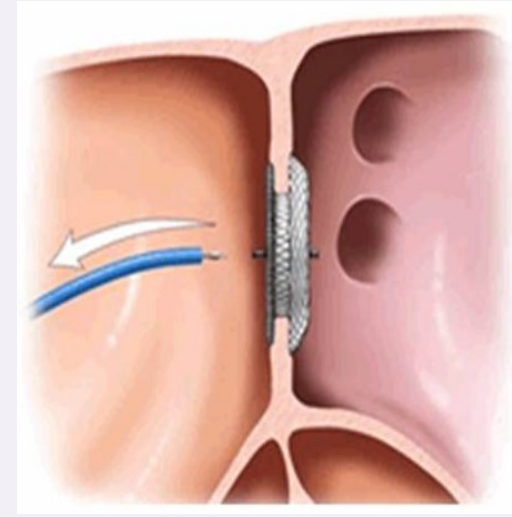
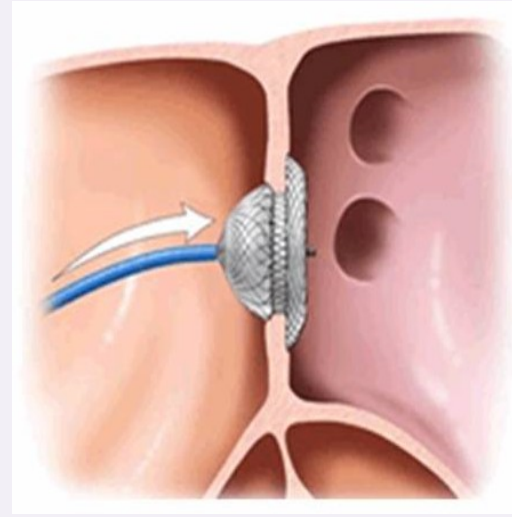
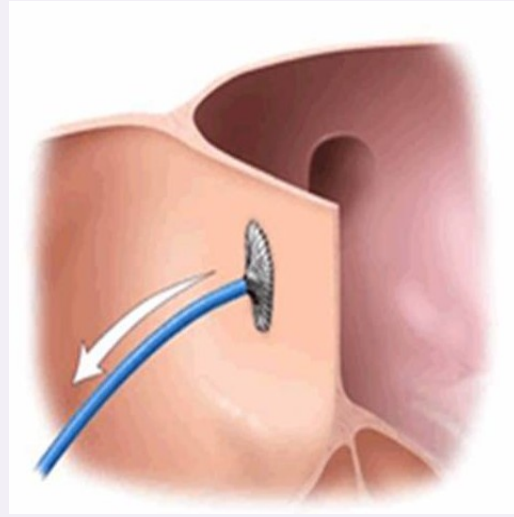
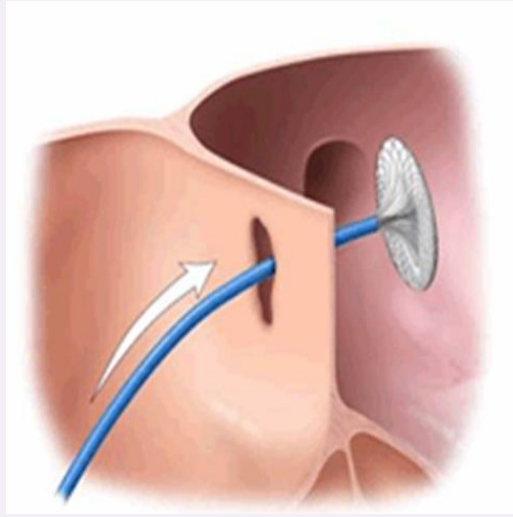
symptoms in adult – enlarging RA, RV, RV failure, arrhythmia

↑ CVP - paradoxical embolism

surgery x catheterization



Atrial septal defect - closure



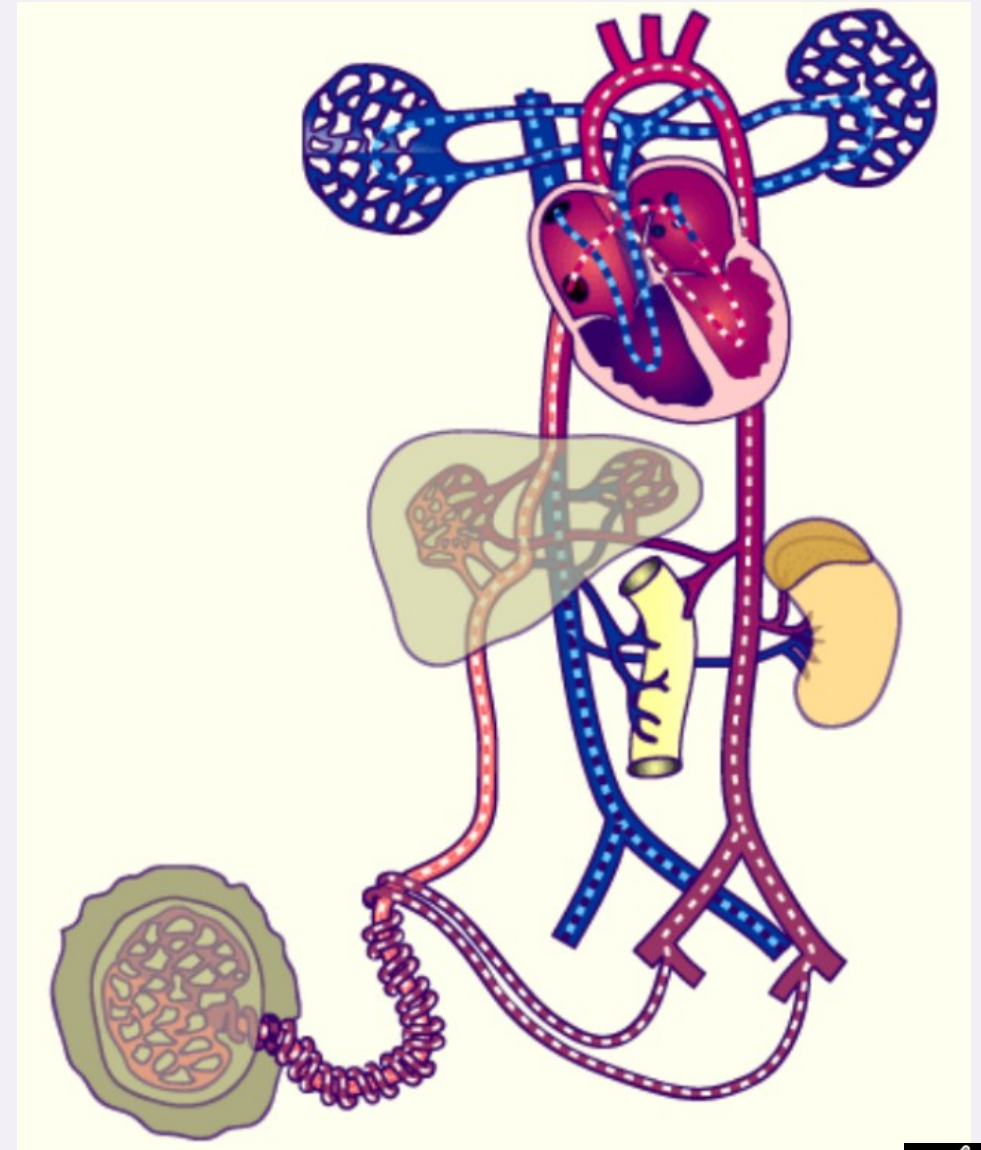
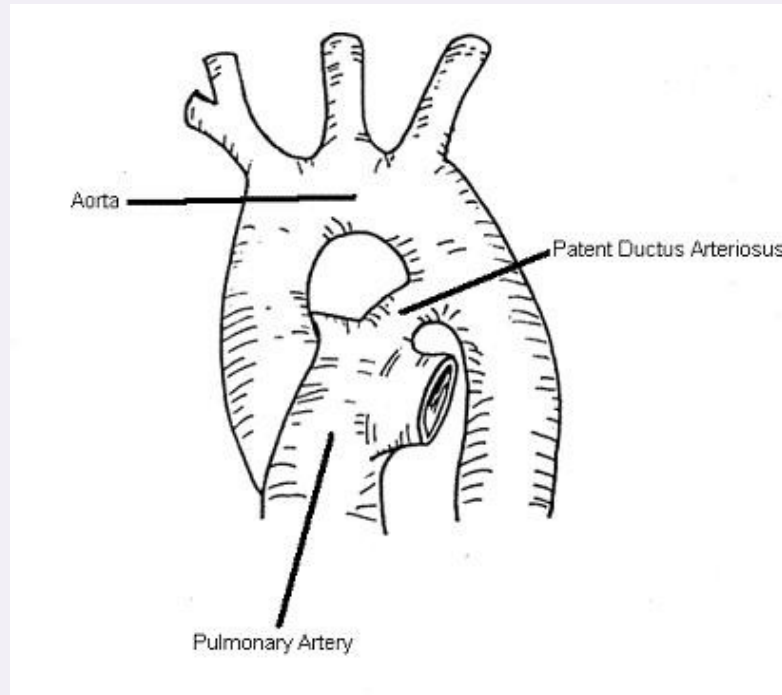
Persistent open arterial duct

Extracardial connection

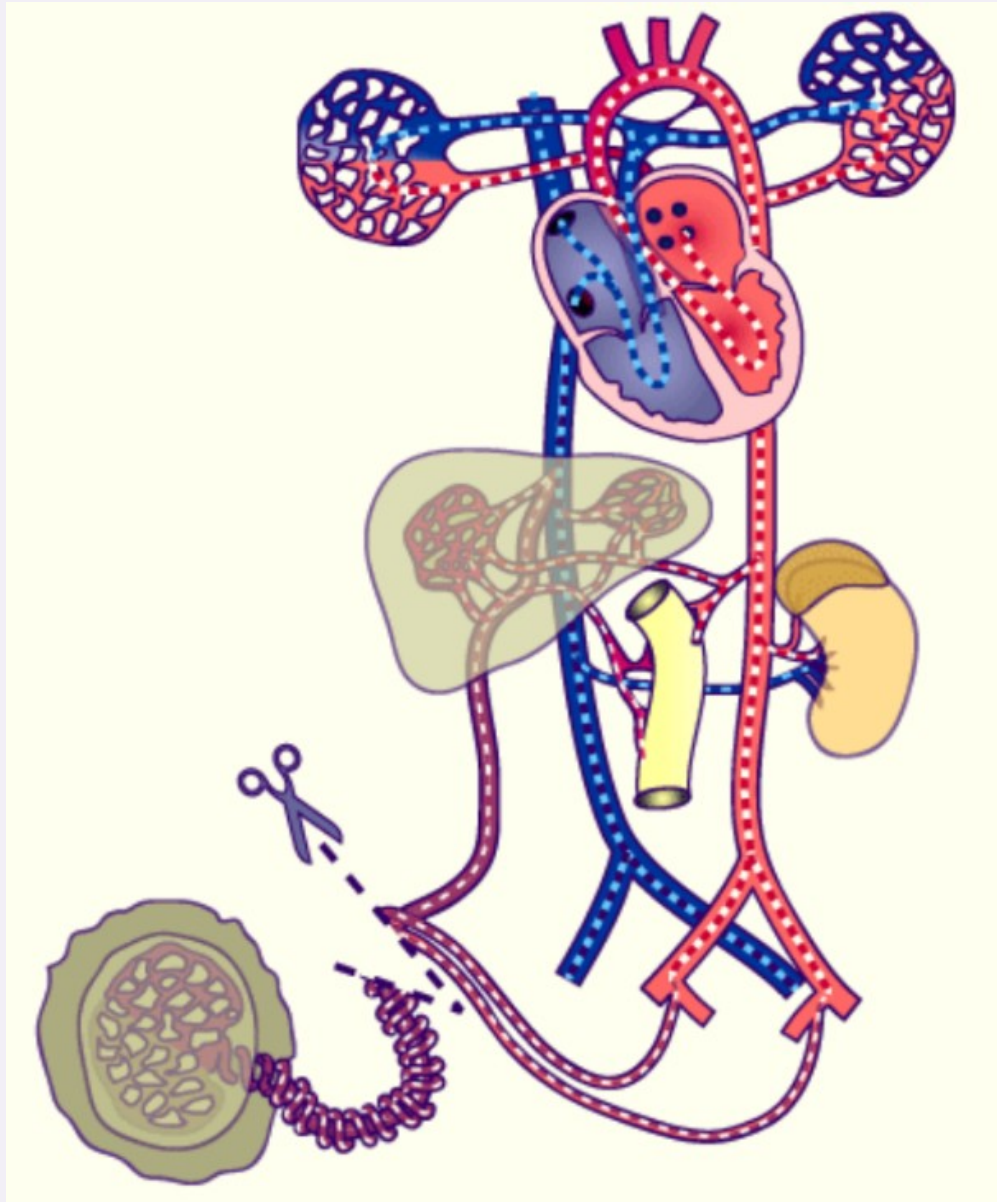
– pulmonary and systemic circulation

During fetal circulation

- ↑ prostaglandins (E2, E1) → persistent connection

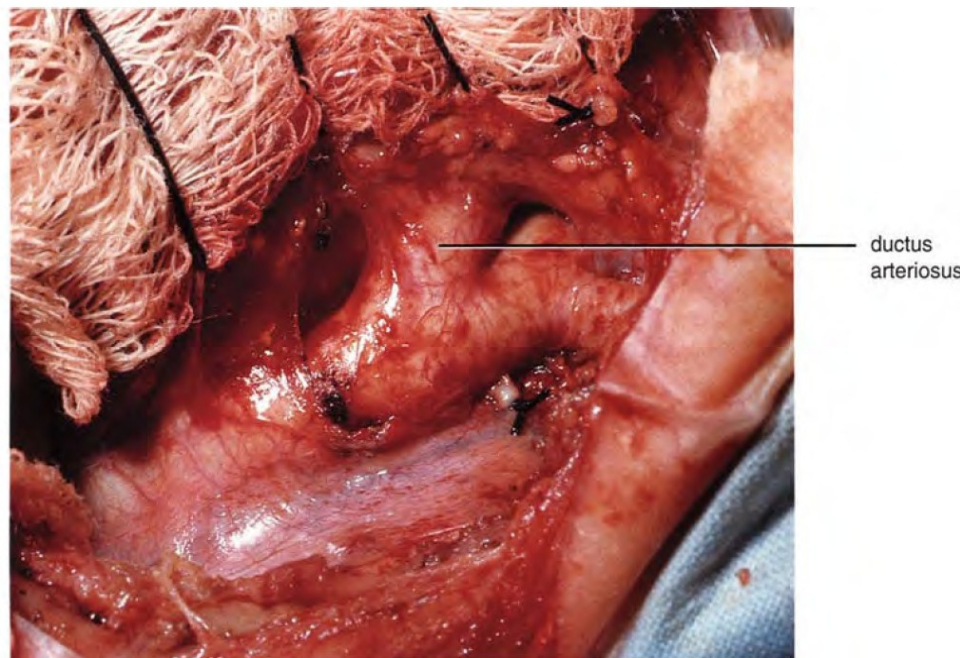


Persistent open arterial duct



After birth $\uparrow pO_2$ a $\downarrow PG$
(placental removal)

5-10% all congenital heart diseases
In prematurely born 20-30%



Persistent open arterial duct (persistent ductus arteriosus)

farmacotherapy - ibuprofen - PG inhibitors

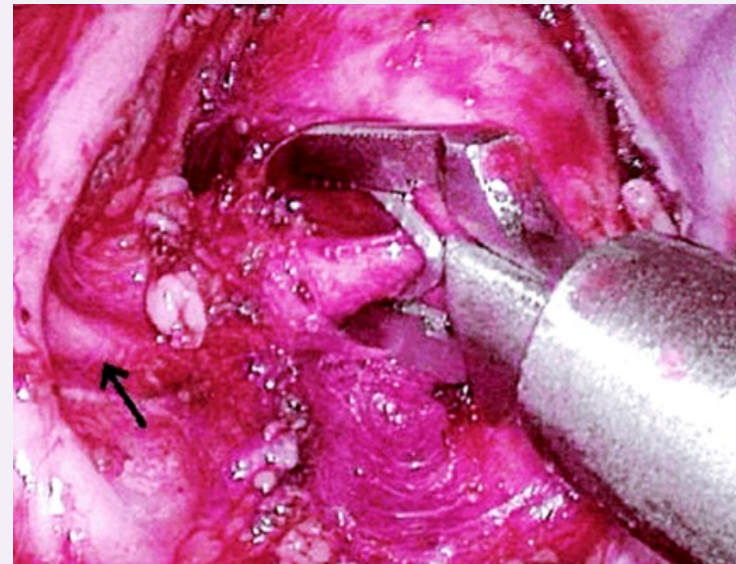
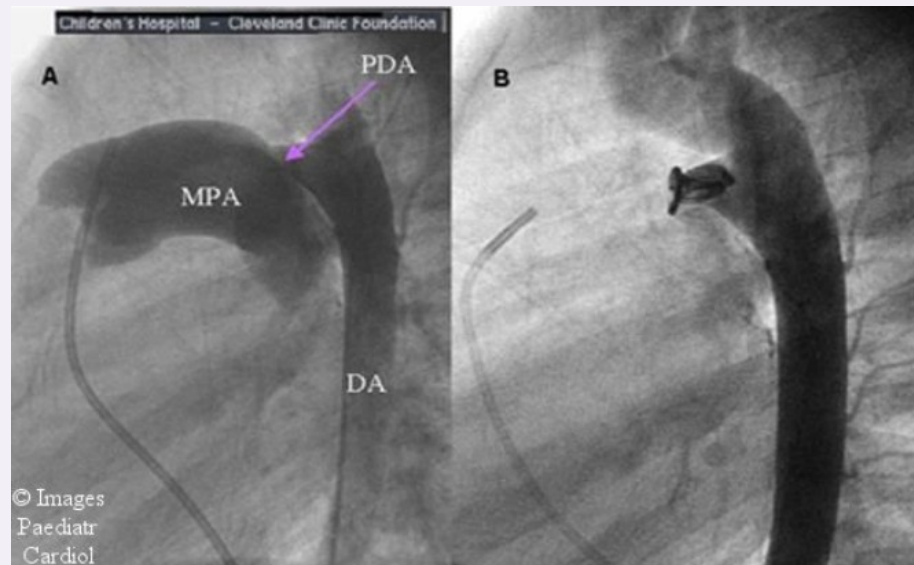
cathetrization

surgery - VATS

- „open surgery“ - thoracotomy

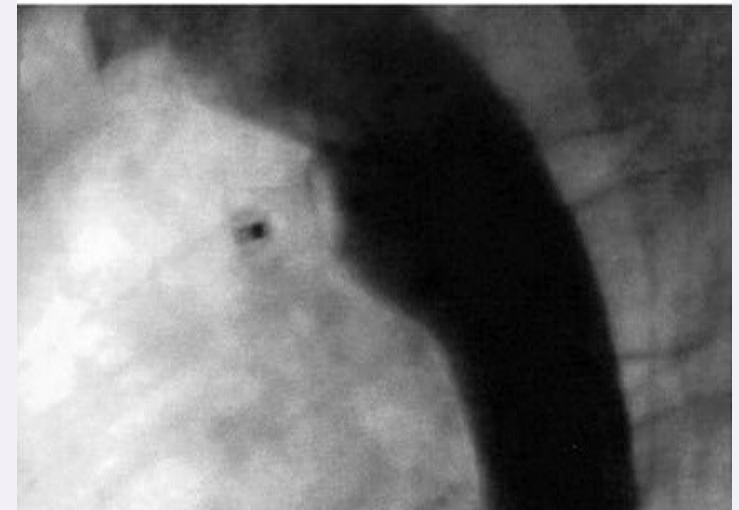
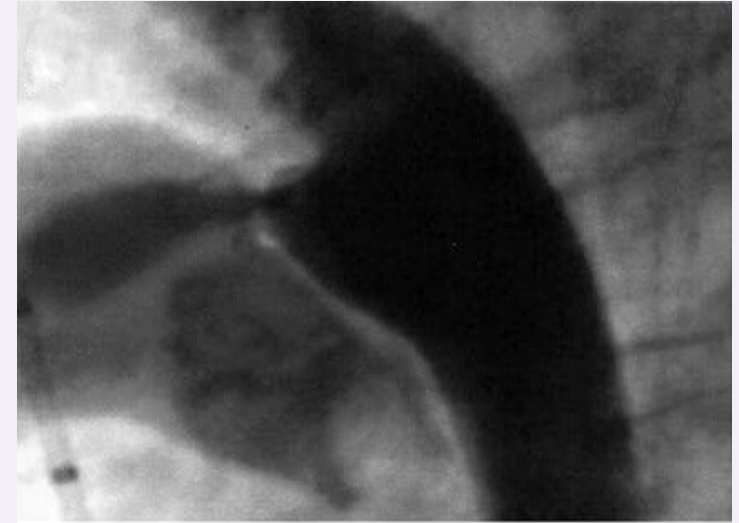
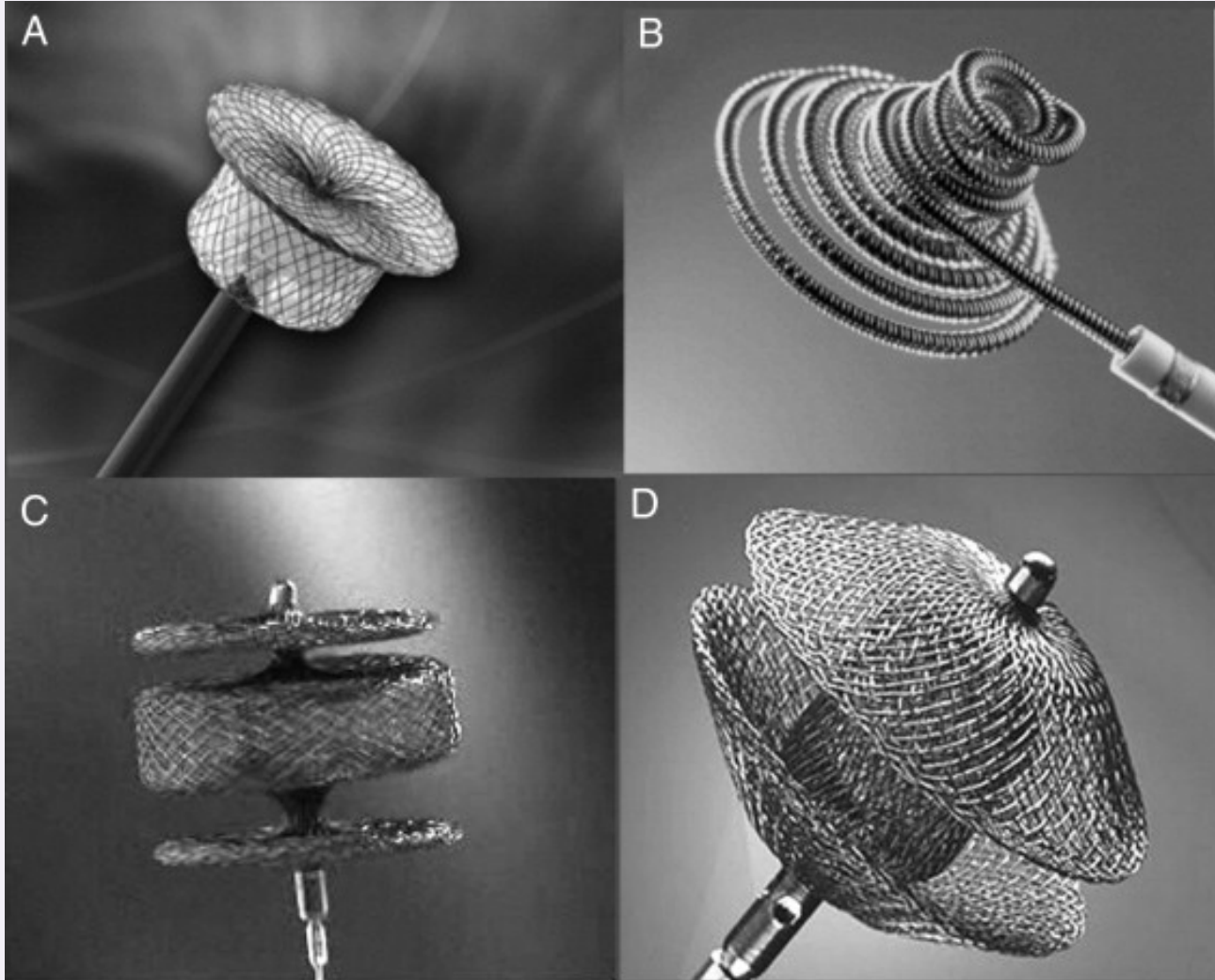
Closing is making except for disorders, when PDA is important for survival.

- PG E1 - (pulmonary stenosis, HLHS, TGA)



Types of closure devices

Rashkind, Amplatz, coil



Congenital heart diseases

Congenital

- without shunt
- left-to-right shunt
- **right-to-left shunt - cyanotic**
- tetralogy of Fallot
- TGA

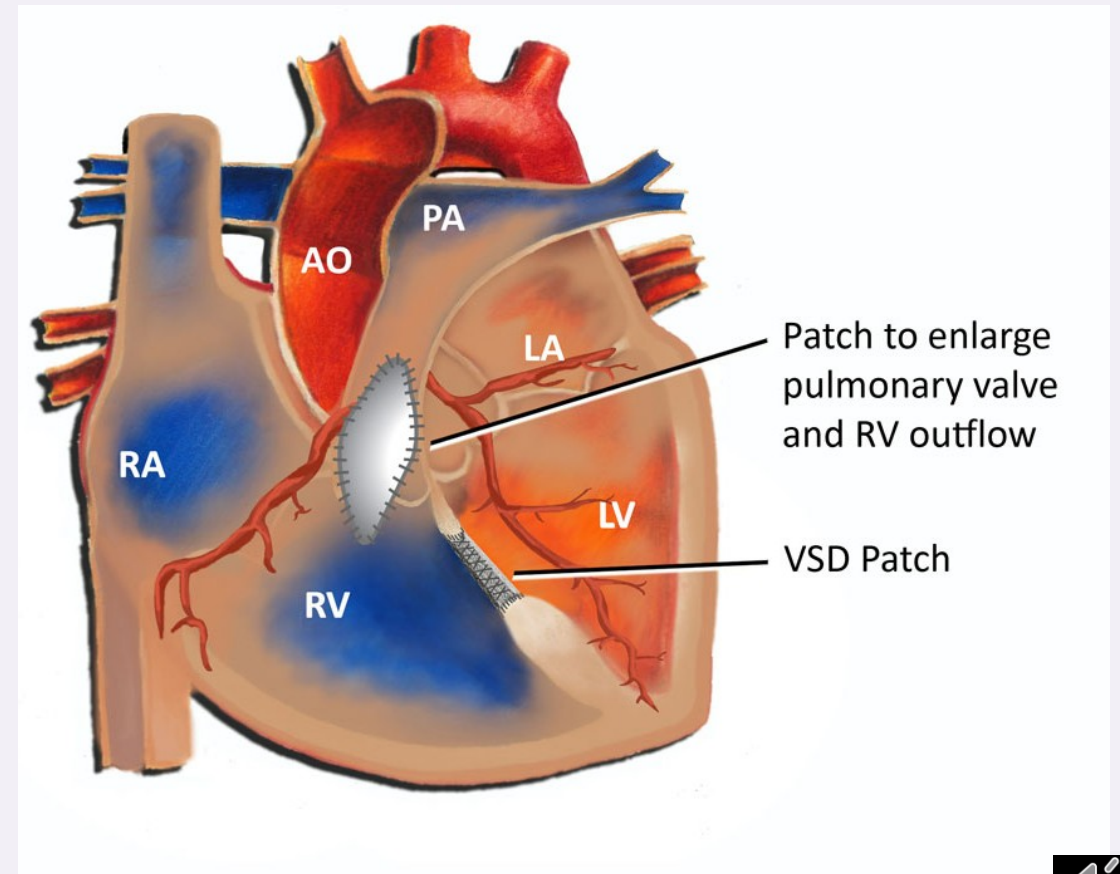
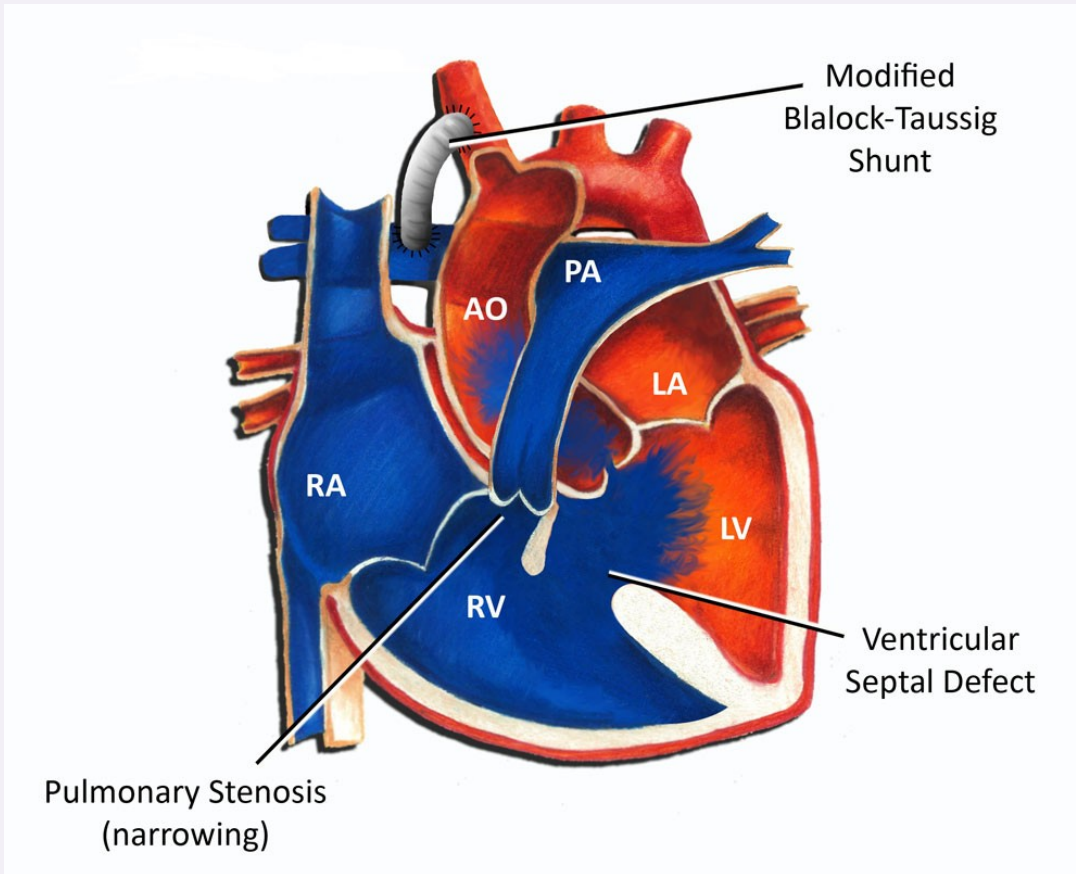
Acquired

- ischemic heart diseases
- valve diseases
- aortic diseases
- tumors
- others
- VSD with pulmonary atresia
- total anomalous pulmonary venous return
- truncus arteriosus



Tetralogy of Fallot

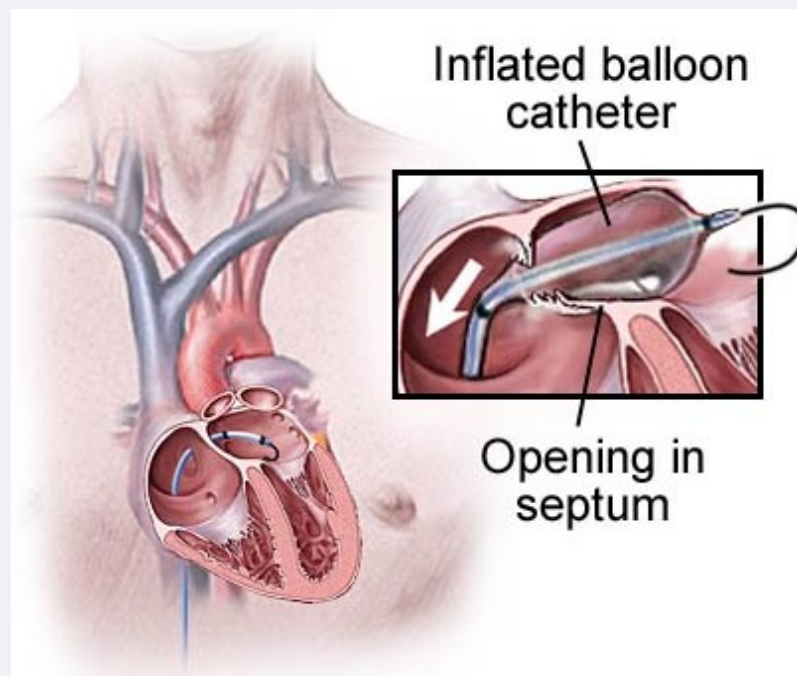
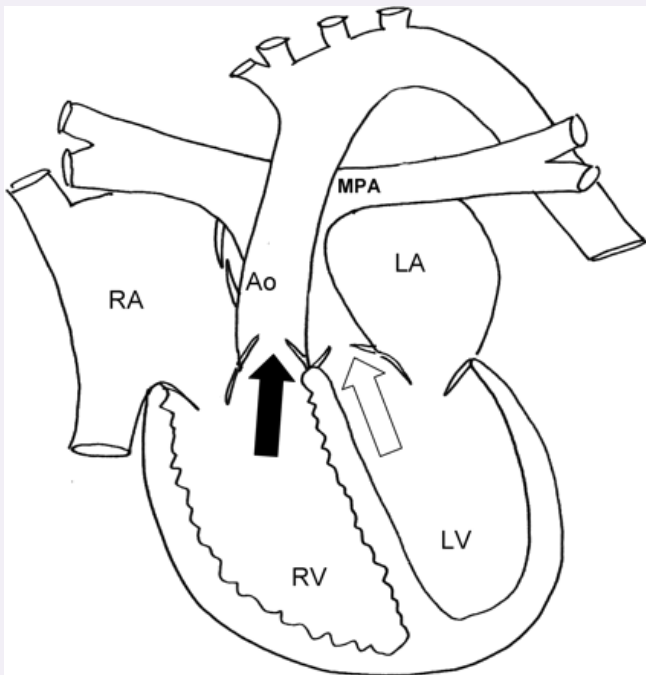
- surgery during first year
- observation
- 20% redo surgery in adult



Transposition of great arteries - dTGA

1. dextro-transposition of the great arteries (d-TGA)

- also **complete transposition of the great arteries**. The primary arteries (the aorta and the pulmonary artery) are transposed.
- cyanotic congenital heart defect
- this condition is described as **ventriculoarterial discordance with atrioventricular concordance**,



Transposition of great arteries - ccTGA

2. levo-transposition of the great arteries (l-TGA)

also congenitally corrected transposition of the great arteries (**cc-TGA**),

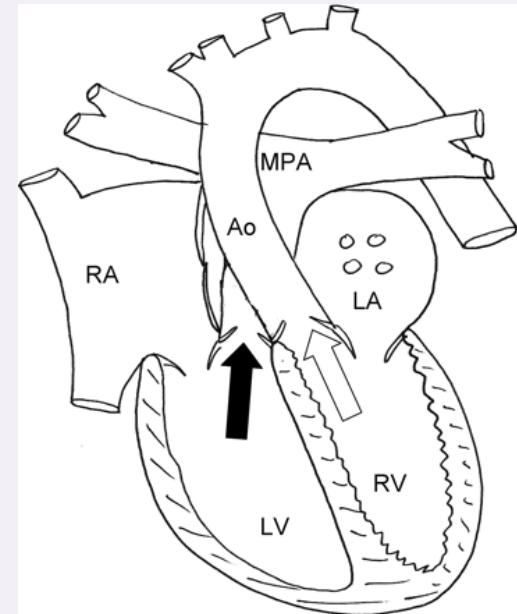
- non-cyanotic congenital heart defect (**CHD**)

- the aorta and the pulmonary artery are transposed

- morphological left and right ventricles are also transposed. This condition is described as **atrioventricular discordance (ventricular inversion) with ventriculoarterial discordance**.

Problem?

The systemic ventricle is the RV!



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Transposition of great arteries

Follow-up...., redo surgery

- Senning, Mustard

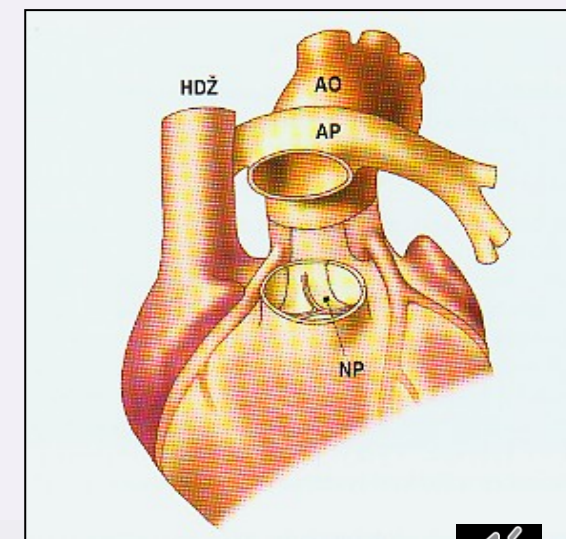
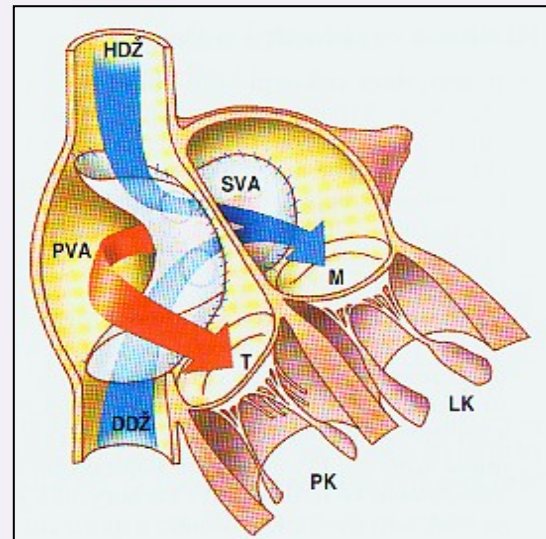
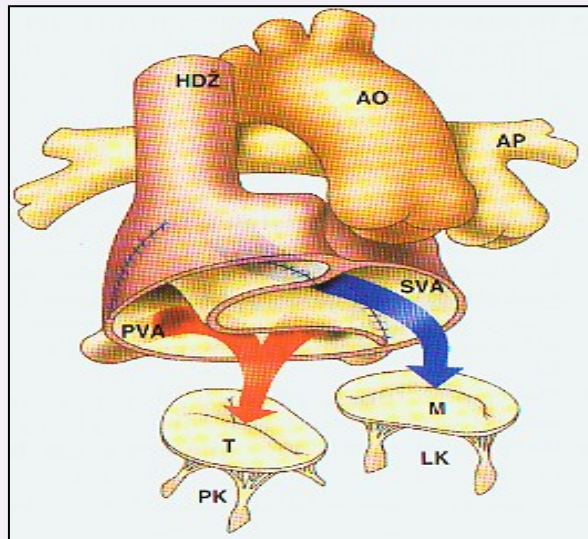
after 30 years - RV dysfunction, TriR, arrhythmia

→ heart transplantation

- switch Jatene

supravalvular AoS, pulmonary stenosis; neo-aortic root dilatation;

coronary artery stenosis



Acquired heart diseases

Congenital

- without shunting
- left to right shunt
- right to left shunt

Acquired

- **ischemic heart diseases**
- **valve diseases**
- **aortic diseases**
- **tumors**
- **others**



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IHD – risk factors, signs, symptoms, therapy

- **hypertension**
- **diabetes**
- **obesity**
- **smoking**
- **hyperlipoproteinemia**
- ...

- **no symptoms**
- **angina pectoris**
- **myocardial infarction**
- **heart failure, sudden death**

PREVENTION!!!

- **drugs**

- **percutaneous coronary intervention**

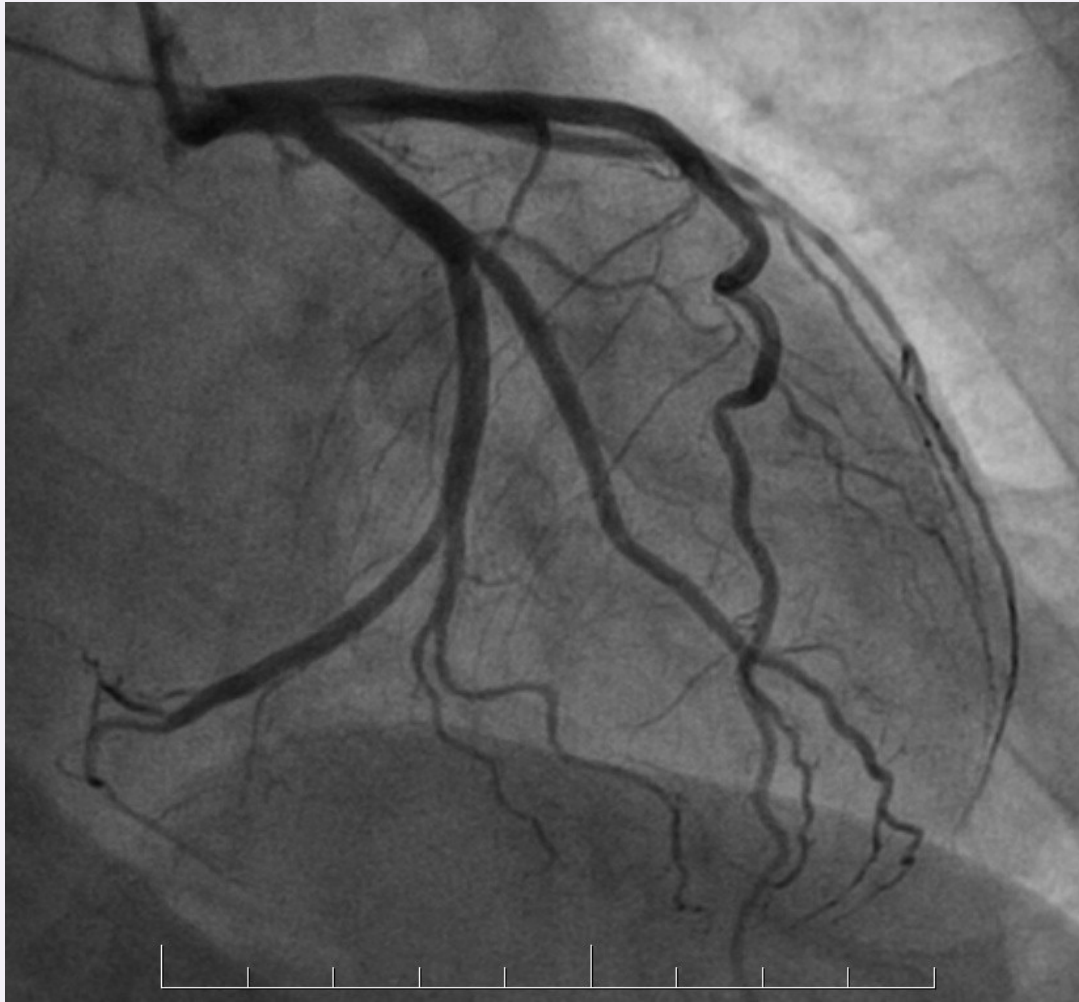
- **surgical revascularization**

- **combination**

- **heart transplantation**



Coronary arteries



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Coronarogram – ischemic heart disease



IHD – indication for surgical treatment

Clinical

- stable angina pectoris
- instable angina
- MI without possibility of intervention
- postinfarction angina

Anatomical

- number of arteries with stenosis (left main coronary artery, one, two, three arteries...)
- grade and localization of coronary artery stenosis
- possibility of surgical treatment
(diffuse coronary artery disease, artery diameter, myocardial viability)



IHD – surgical treatment options

without C-P bypass – „off-pump“

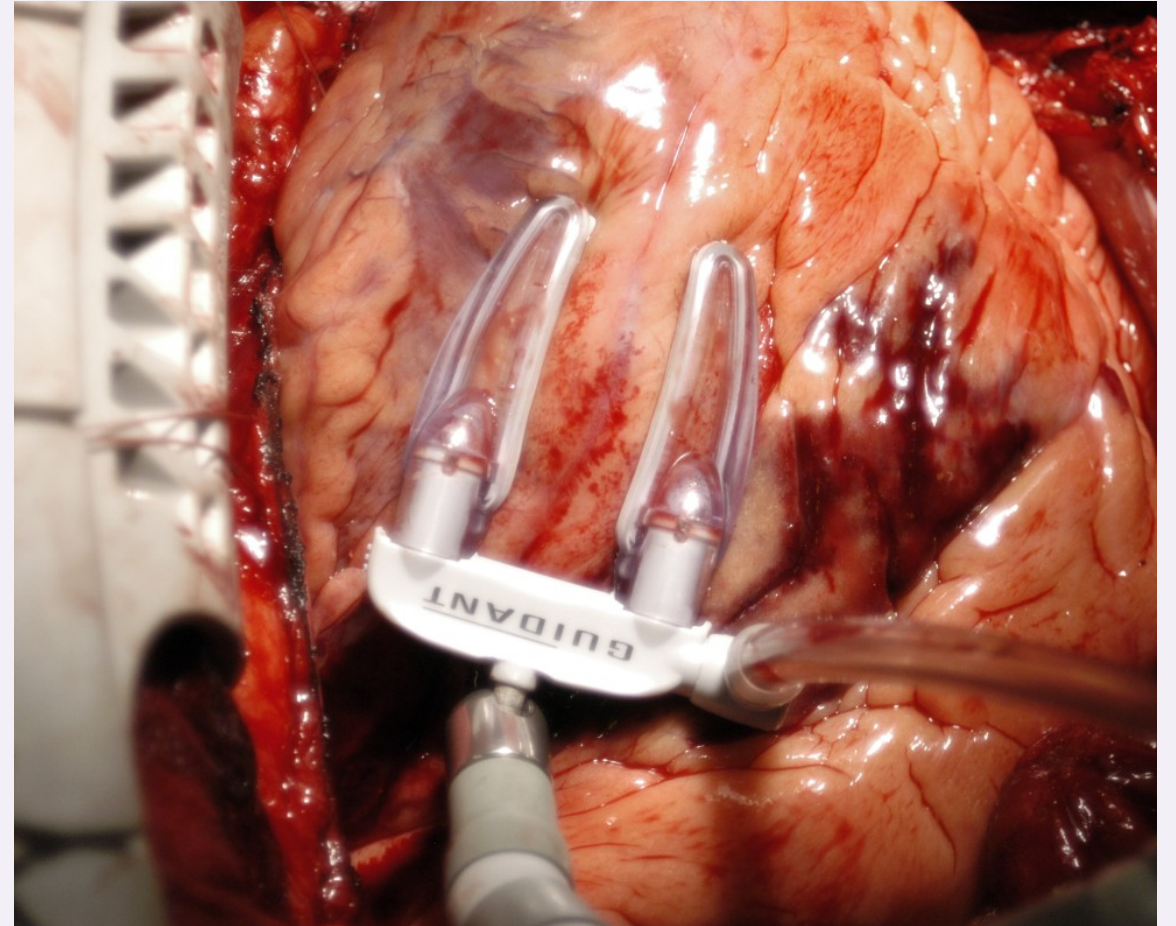
with C-P bypass

sternotomy

minithoracotomy

endoscopic

robotic



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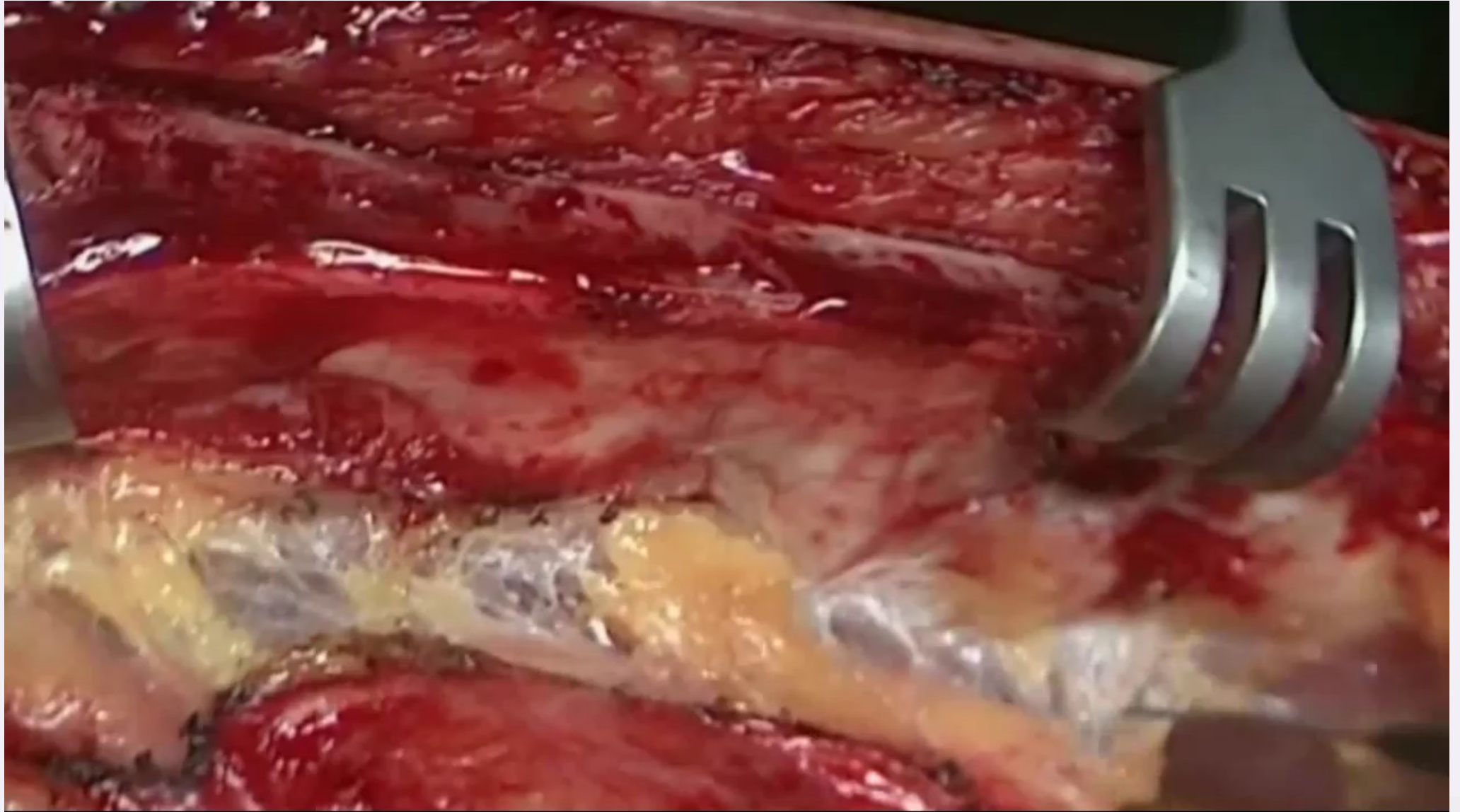


Choice of conduits for coronary artery bypass

Arterial

- LITA (a. thoracica int. l. sin) – 10 years patency 90-95%
- RITA

LIMA harvesting



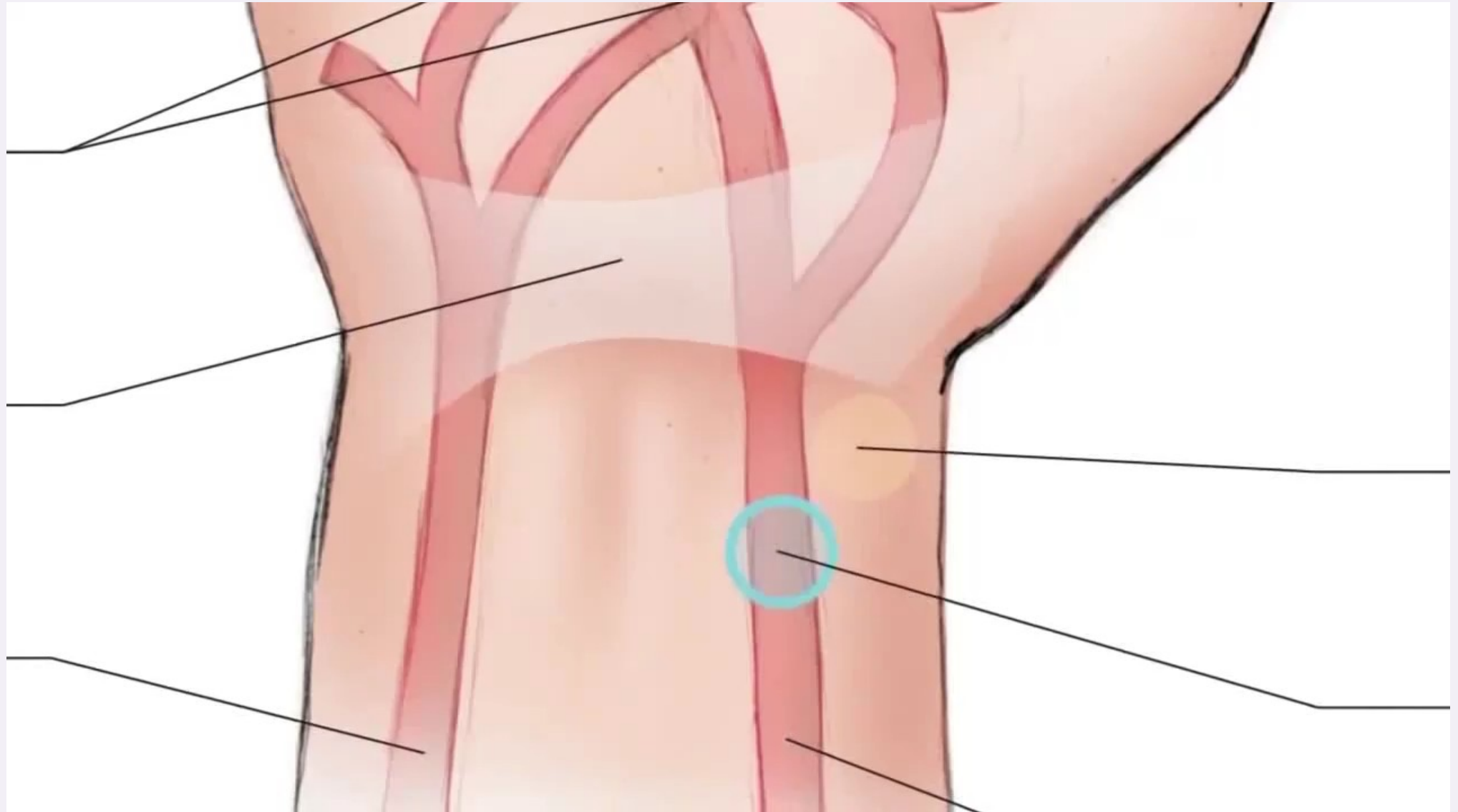
Choice of conduits for coronary artery bypass

Arterial

- LITA (a. thoracica int. l. sin) – 10 years patency 90-95%
- RITA
- radial artery



Radial artery – Allen's test



Choice of conduits for coronary artery bypass

Arterial

- LITA (a. thoracica int. l. sin) – 10 years patency 90-95%
- RITA
- radial artery
- a. gastroepiploica dx., a. epigastrica inf.



Choice of conduits for coronary artery bypass

Arterial

- LITA (a. thoracica int. l. sin) – 10 years patency 90-95%
- RITA
- radial artery
- a. gastroepiploica dx., a. epigastrica inf.

Venous

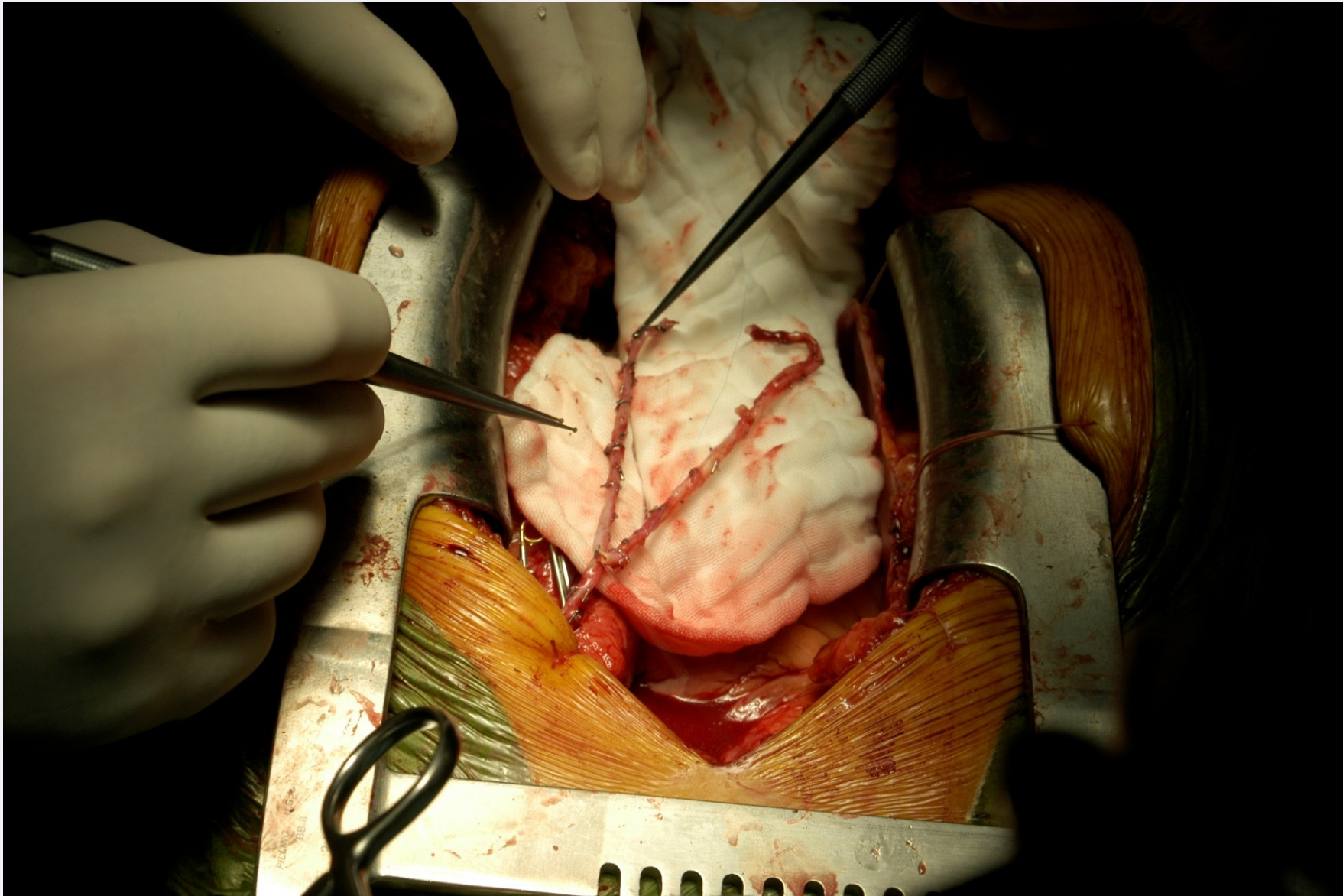
- great saphenous vein – 10 years patency 50-60%
- short saphenous vein
- brachial or cephalic veins from upper arms



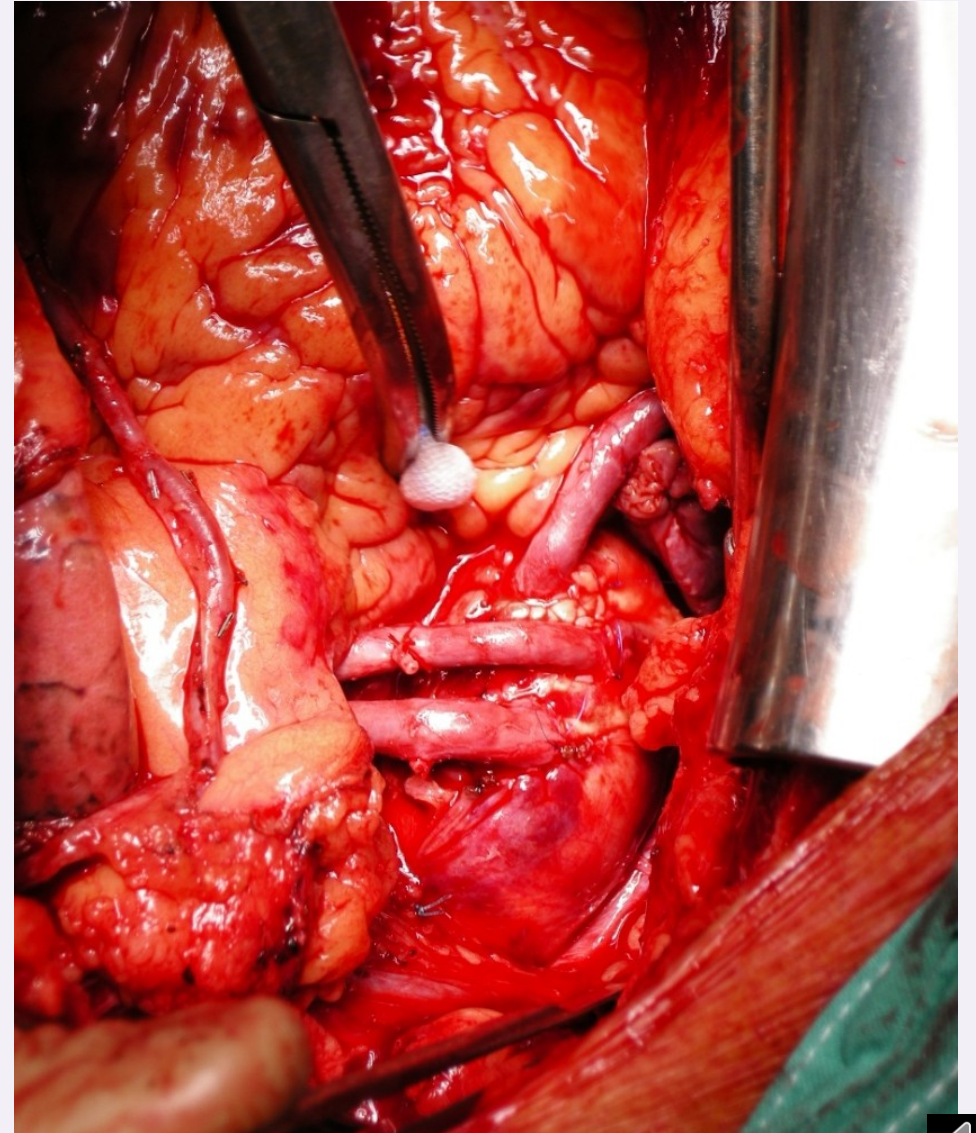
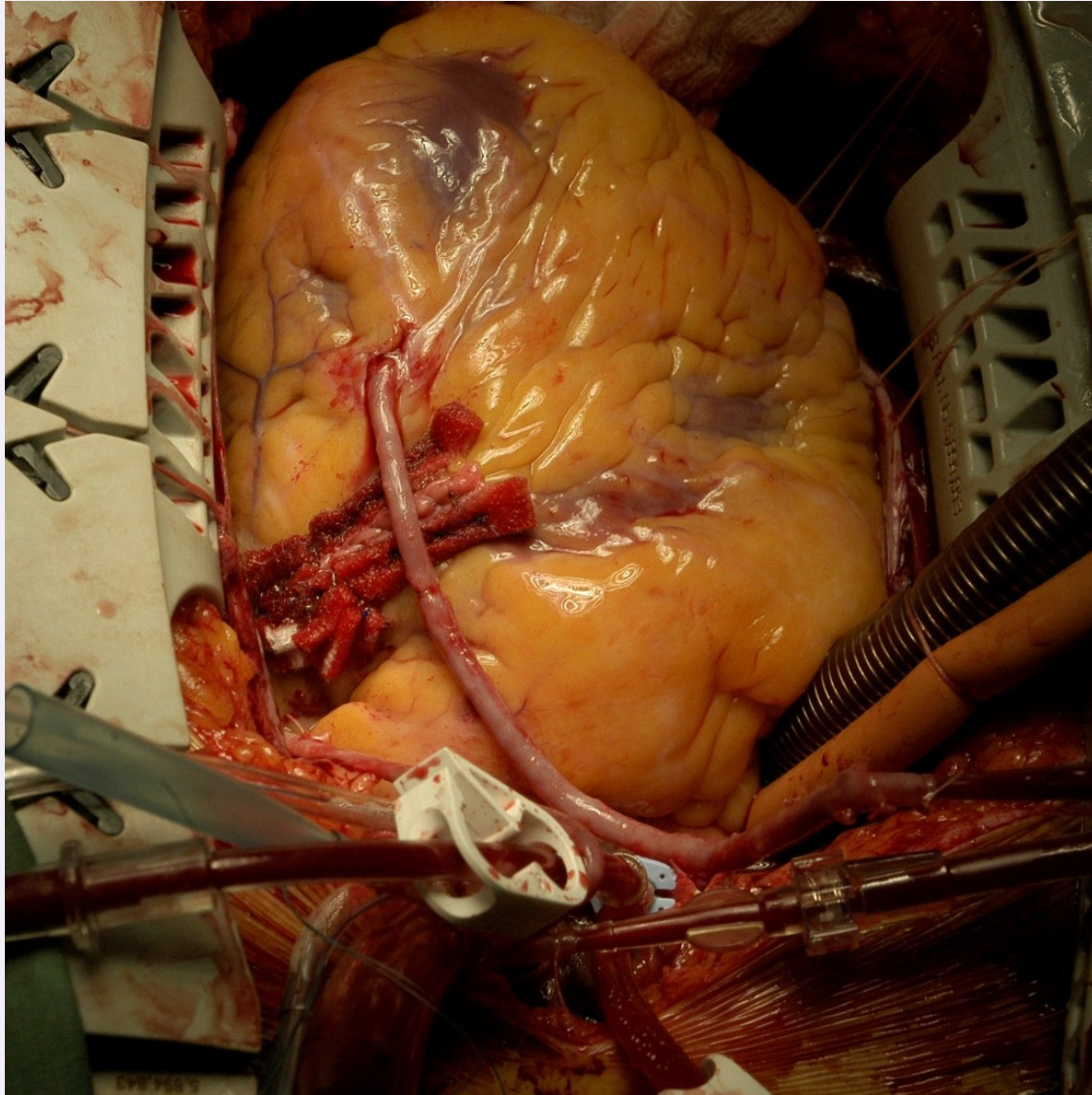
Endoscopic vein harvesting



Choice of conduits for coronary artery bypass



Choice of conduits for coronary artery bypass

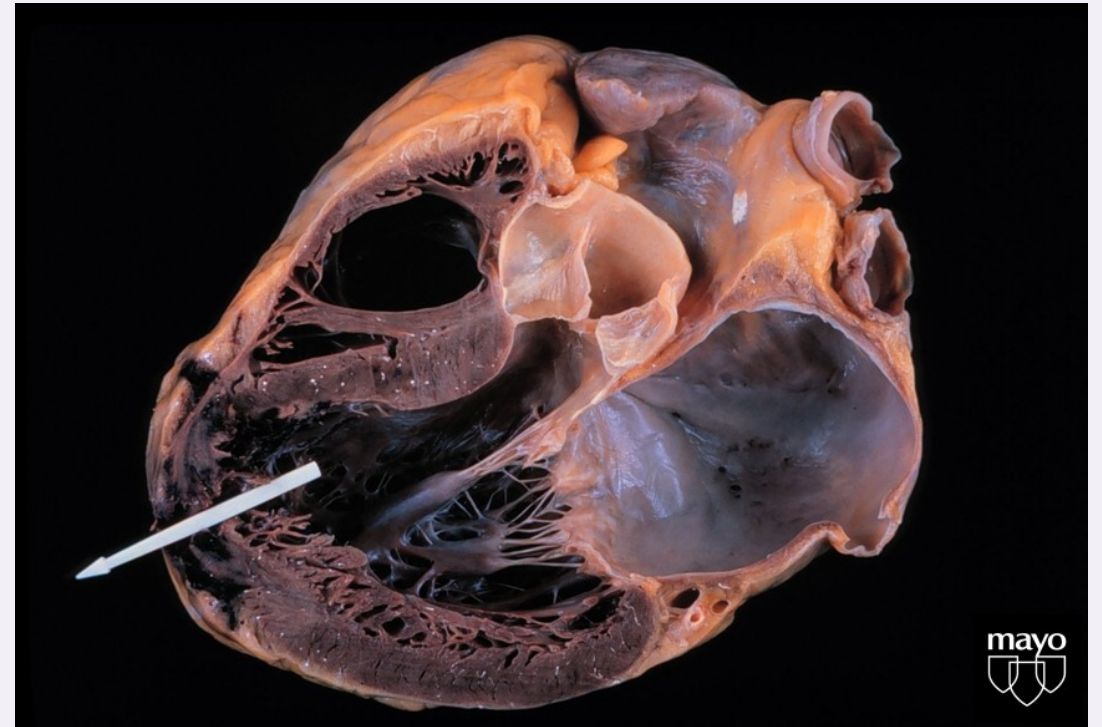
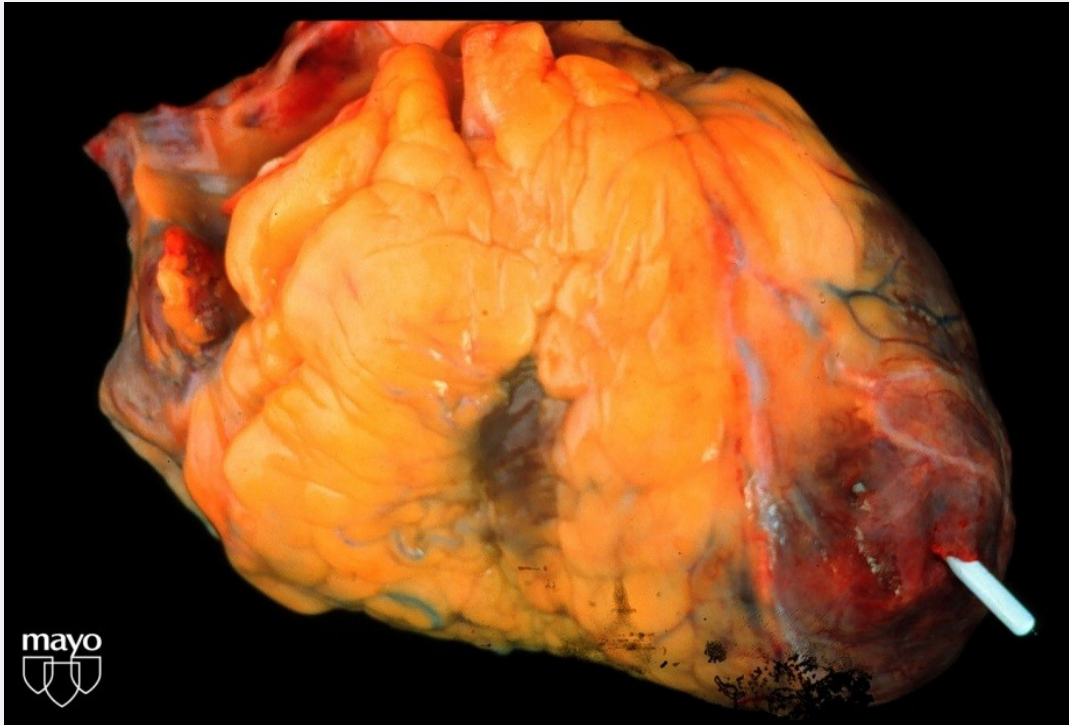


Mechanical complications of acute MI

free wall rupture

VSD

mitral regurgitation



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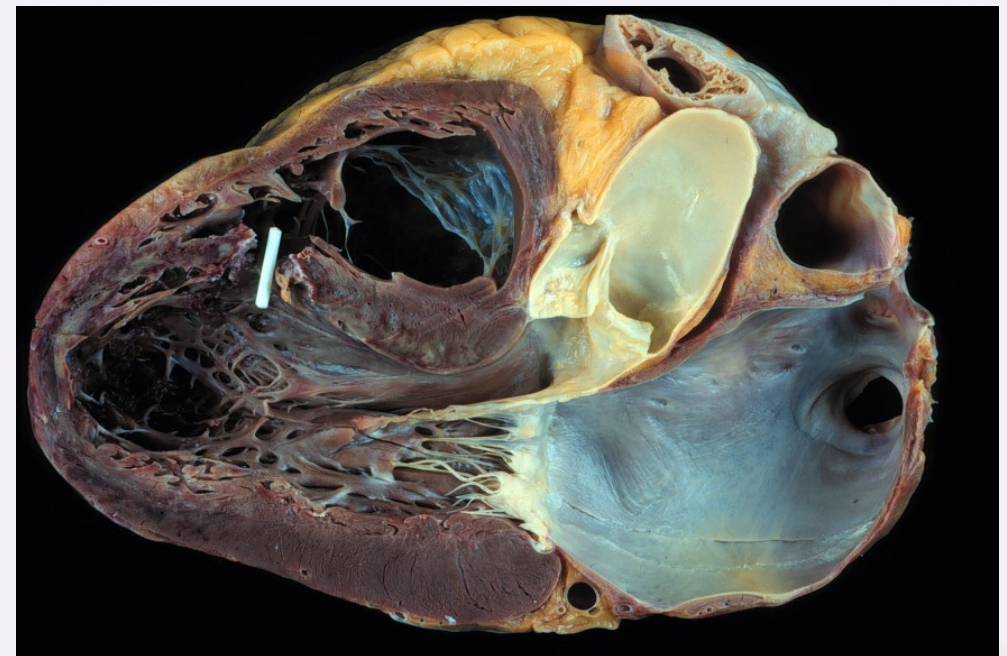
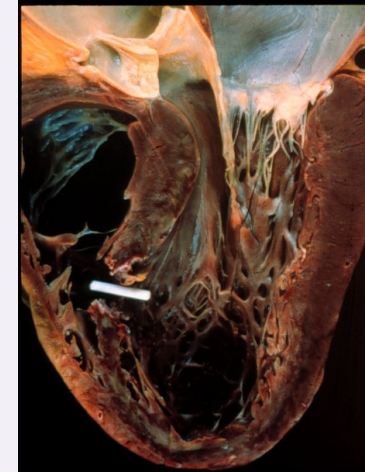


Mechanical complications of acute MI

free wall rupture

VSD

mitral regurgitation

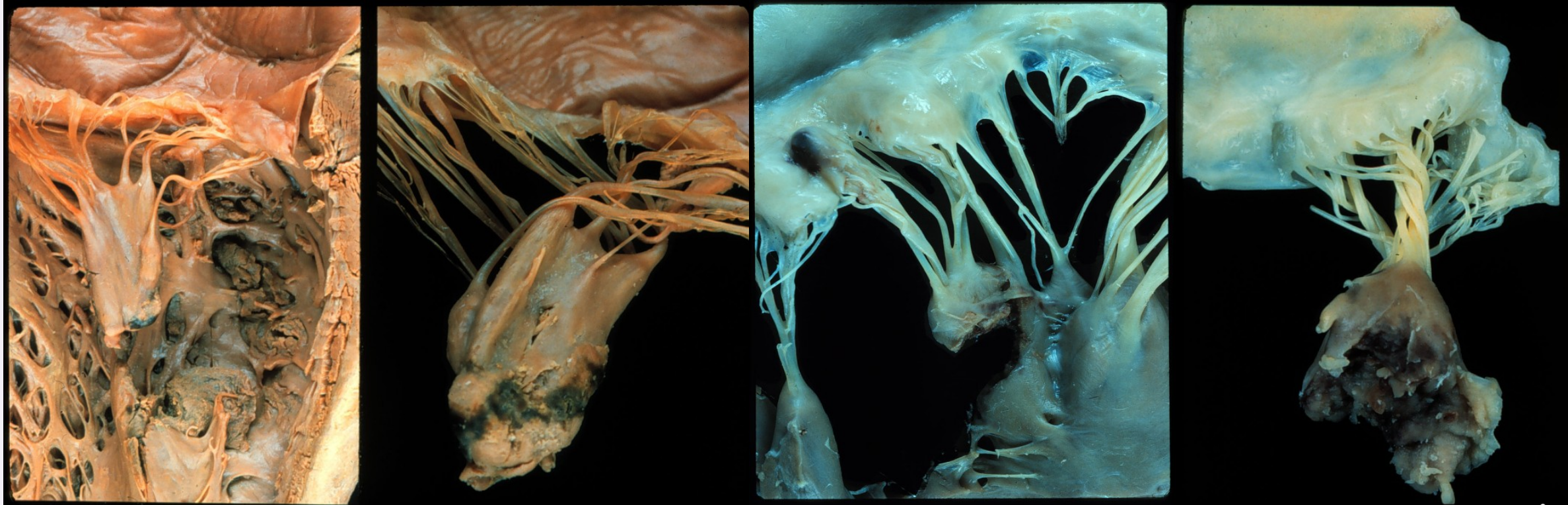


Mechanical complications of acute MI

free wall rupture

VSD

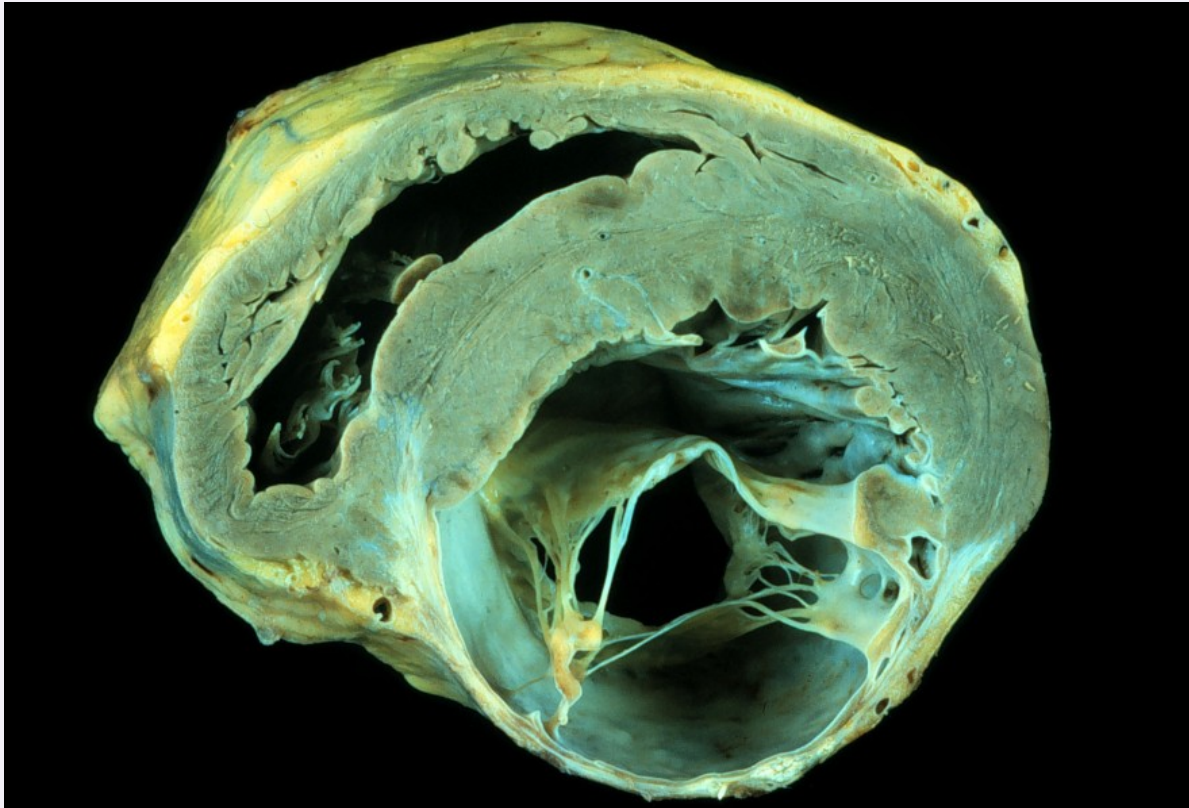
mitral regurgitation – papillary muscle rupture



Mechanical complications of acute MI

LV aneurysm

LV pseudoaneurysm



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Petr Fila
petr.fila@cktch.cz



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Center of Cardiovascular
Surgery & Transplantation

