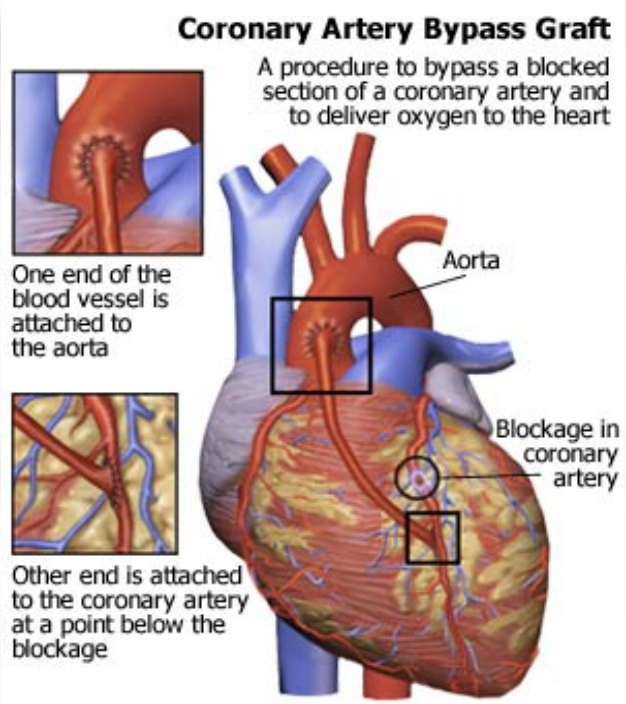
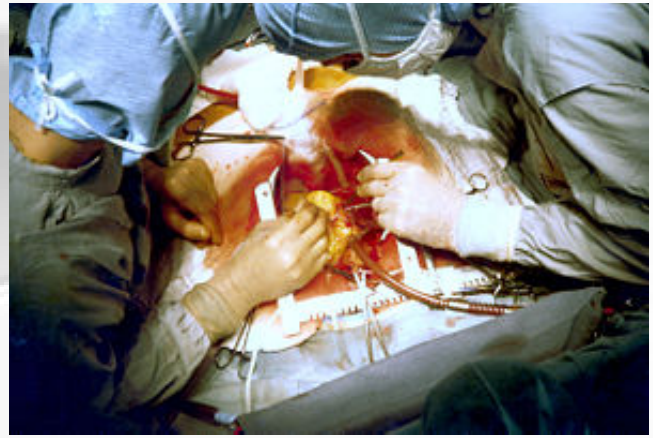
Cardiac Surgery





Presented by Omar AL-Rawajfah, RN, PhD

Lecture Outlines

- Coronary Artery Bypass Graft Surgery
- Minimally invasive cardiac surgery
- Transmyocardial Laser Revascularization
- Cardiac valve surgeries
  - Cardiac valve replacement
  - Cardiac valve repair
- Assessment for patient undergoing cardiac surgery
- Educational perpetration
- Nursing diagnoses
- Collaborative management
  - Intraoperative phase
  - Postoperative phase
  - ICU
  - Intermediate cardiac care unit
- Multidisciplinary outcomes

History

- 1967 the first CABAG surgery in the USA
- First open-heart surgery procedure in Jordan in 1970
- First heart-valve replacement in the country in 1972
- First coronary artery bypass in Jordan in 1973

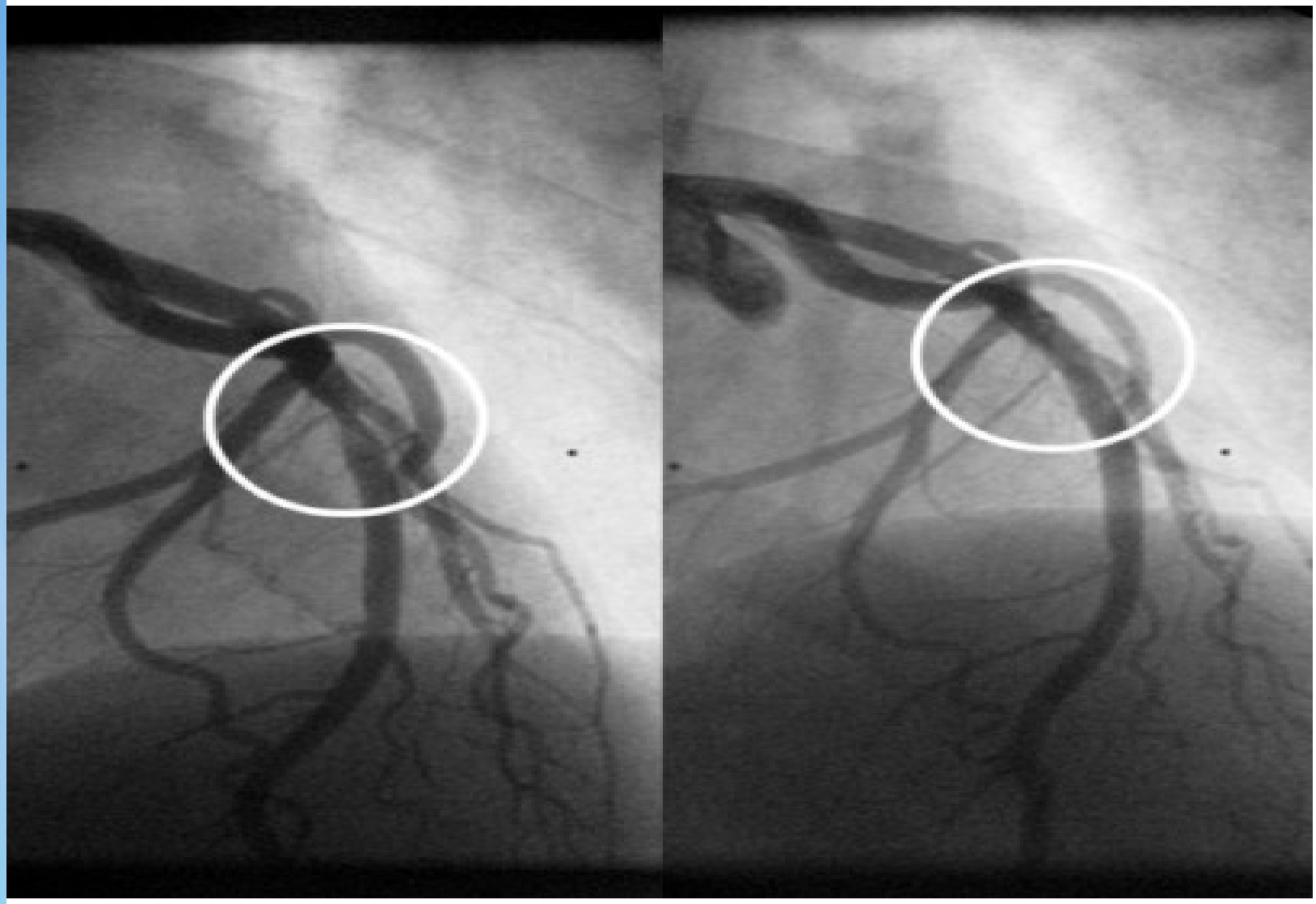
Indication

- The 2004 ACC/ AHA CABG guidelines state CABG is the preferred treatment for:
  - Disease of the Left Main Coronary Artery Disease of all three coronary vessels (LAD, LCX, & RCA).
  - Diffuse disease not amendable to treatment with a PTCA.
- Factors associated with bypass surgery
  - Age, pervious heart surgery, LtV EF, percentage of stenosis, number of coronary blood vessels that need grafting

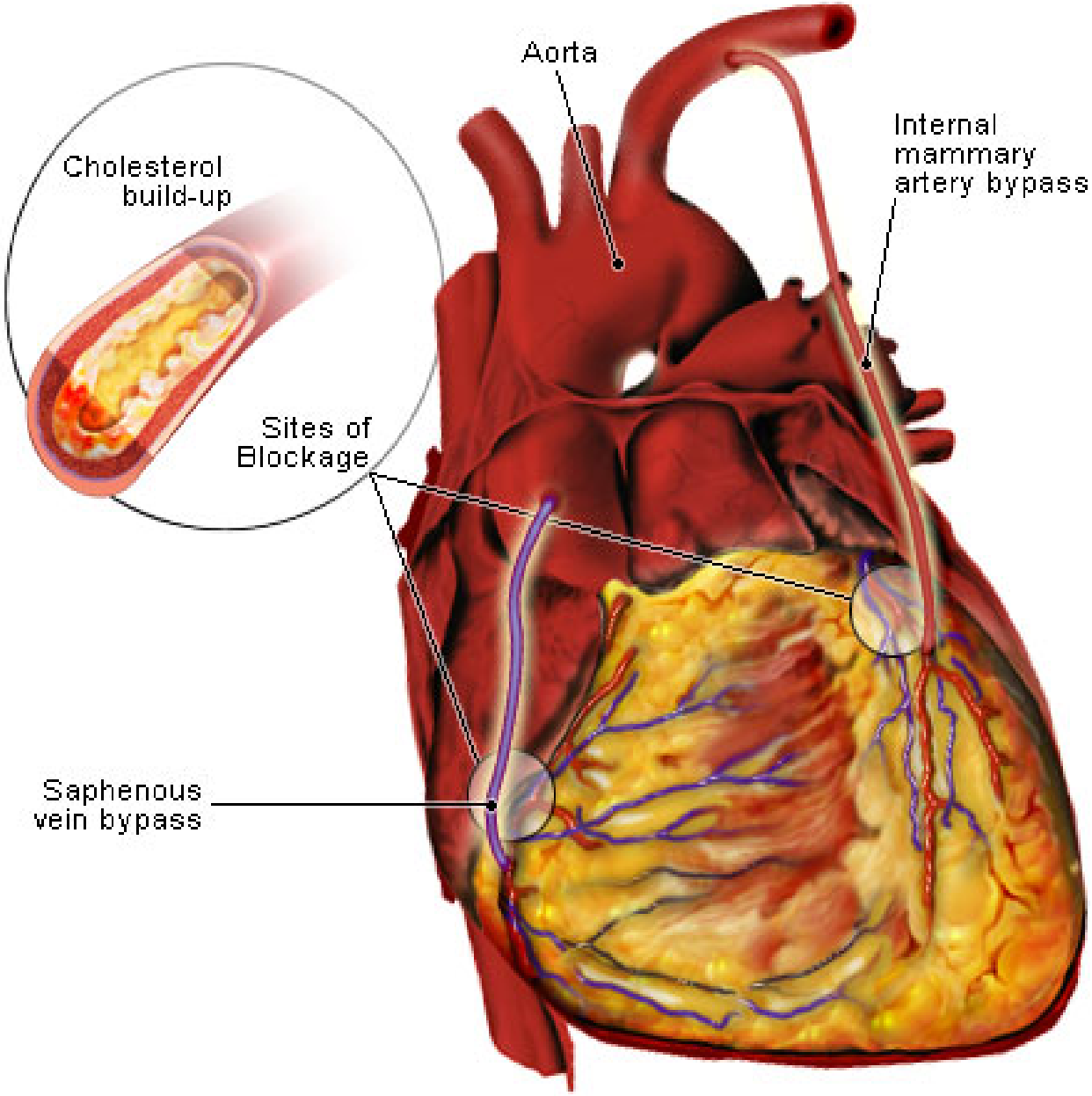
Coronary Artery Bypass Graft Surgery

- Saphenous vein was used to bypass diseased coronary artery
- Arteries has become more popular for bypassing blocked coronary arteries
- Internal thoracic artery (internal mammary artery) is the most common used artery
- Other arteries that have been used are gastroepiploic artery, inferior epigastric artery, less commonly radial artery
- Suphenous vein is associated with lower 5-year patency rate than arteries
- 85%-95% of internal thoracic artery graft are patent 10 years after the surgery
- Gastroepiploic artery is commonly used to by pass blockages in the RCA or posterior descending artery

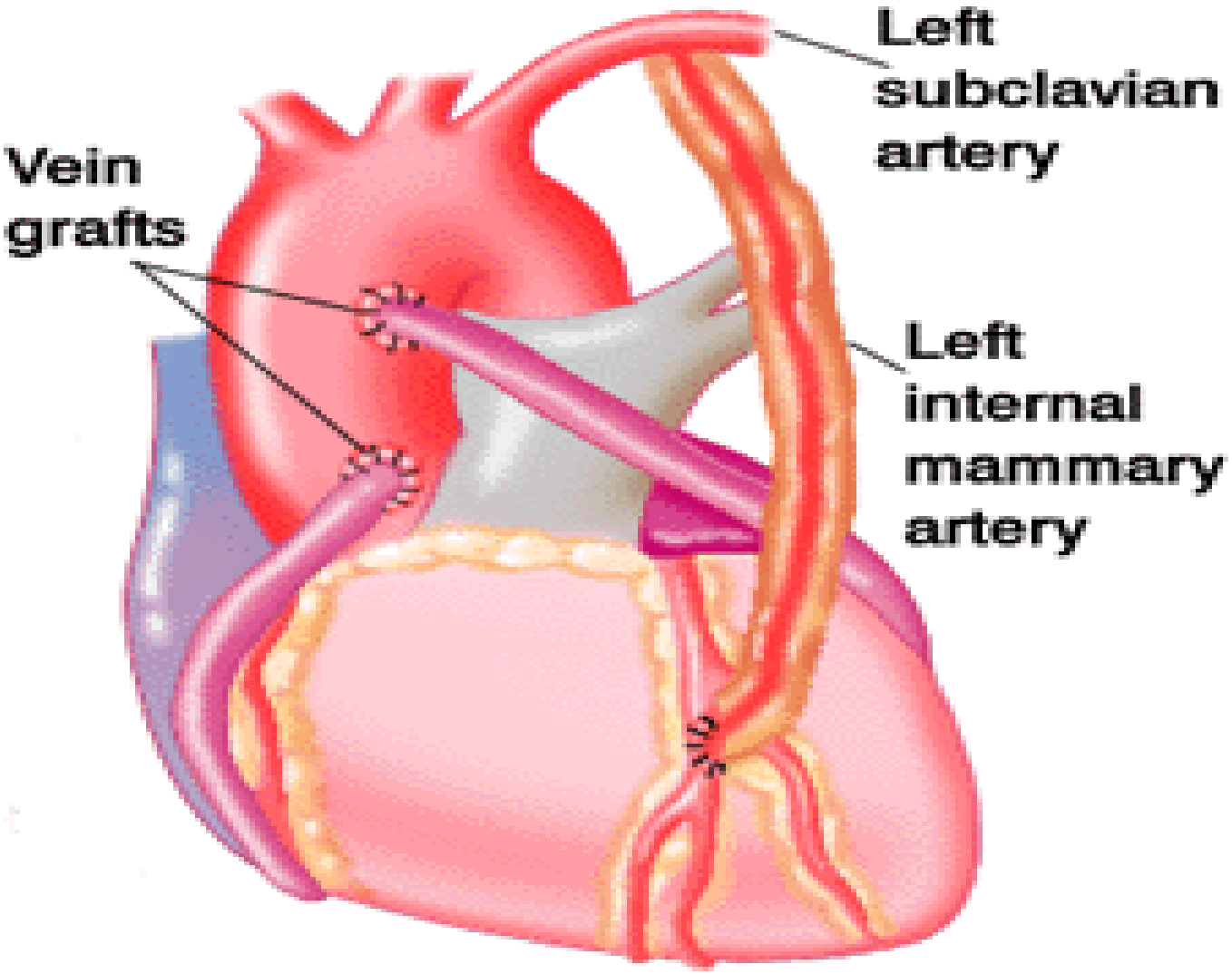
Proximal LAD Stenosis



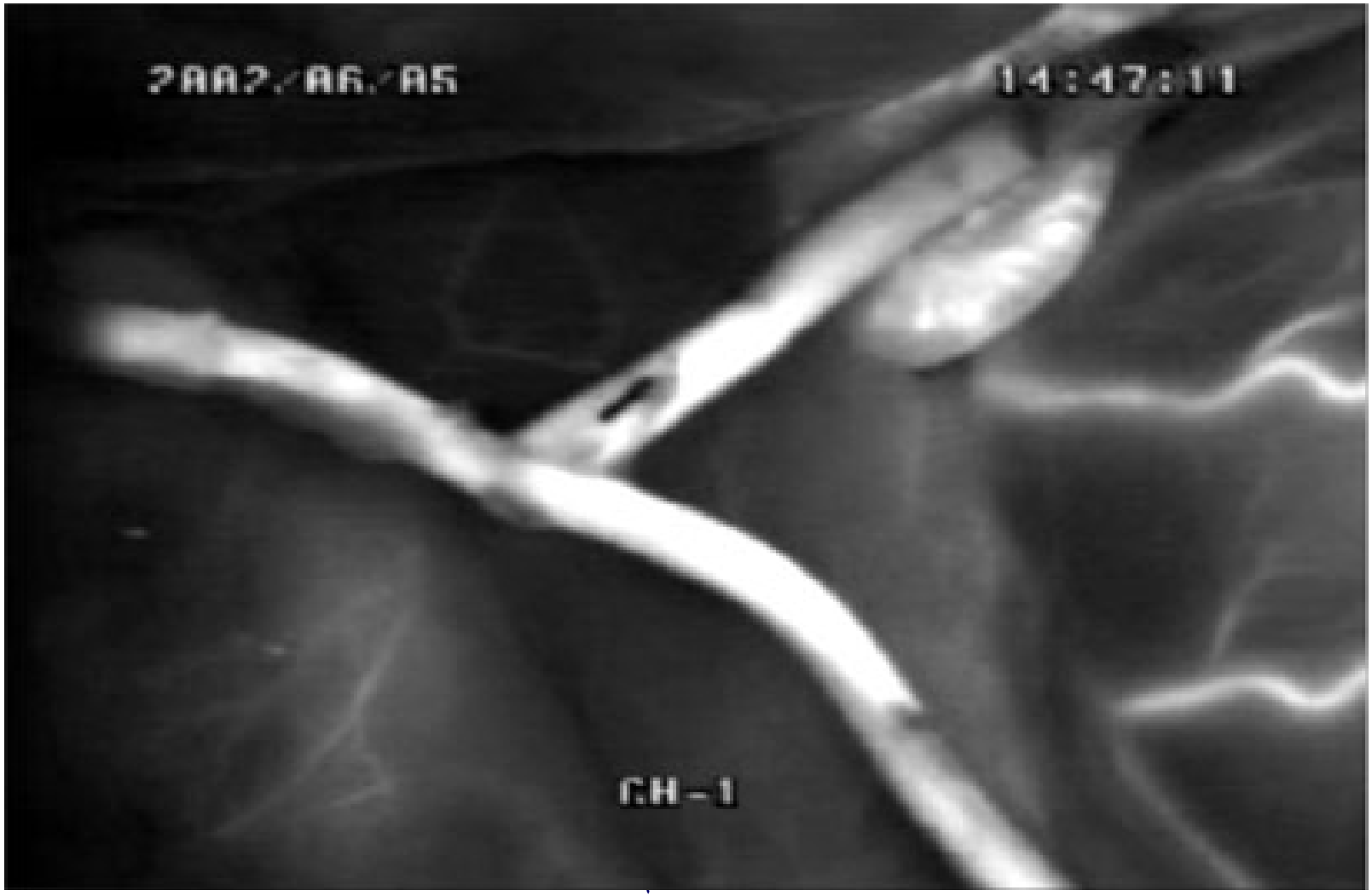
Coronary Artery Bypass



B. View of heart after bypass surgery



SPY Intra-operative Imaging System

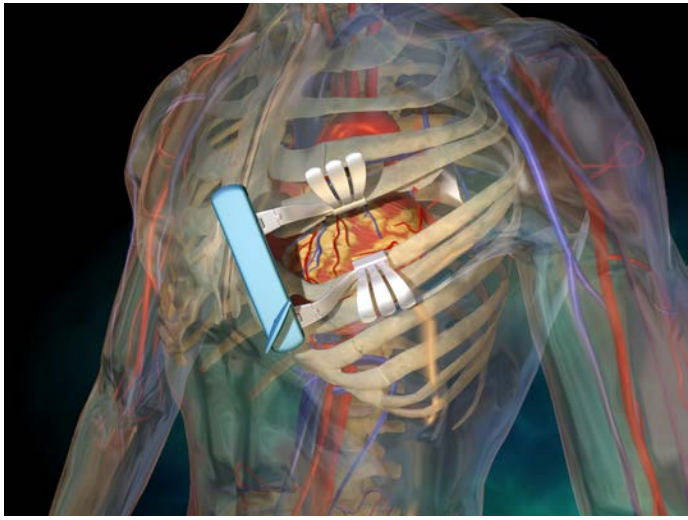


Minimally invasive cardiac surgery

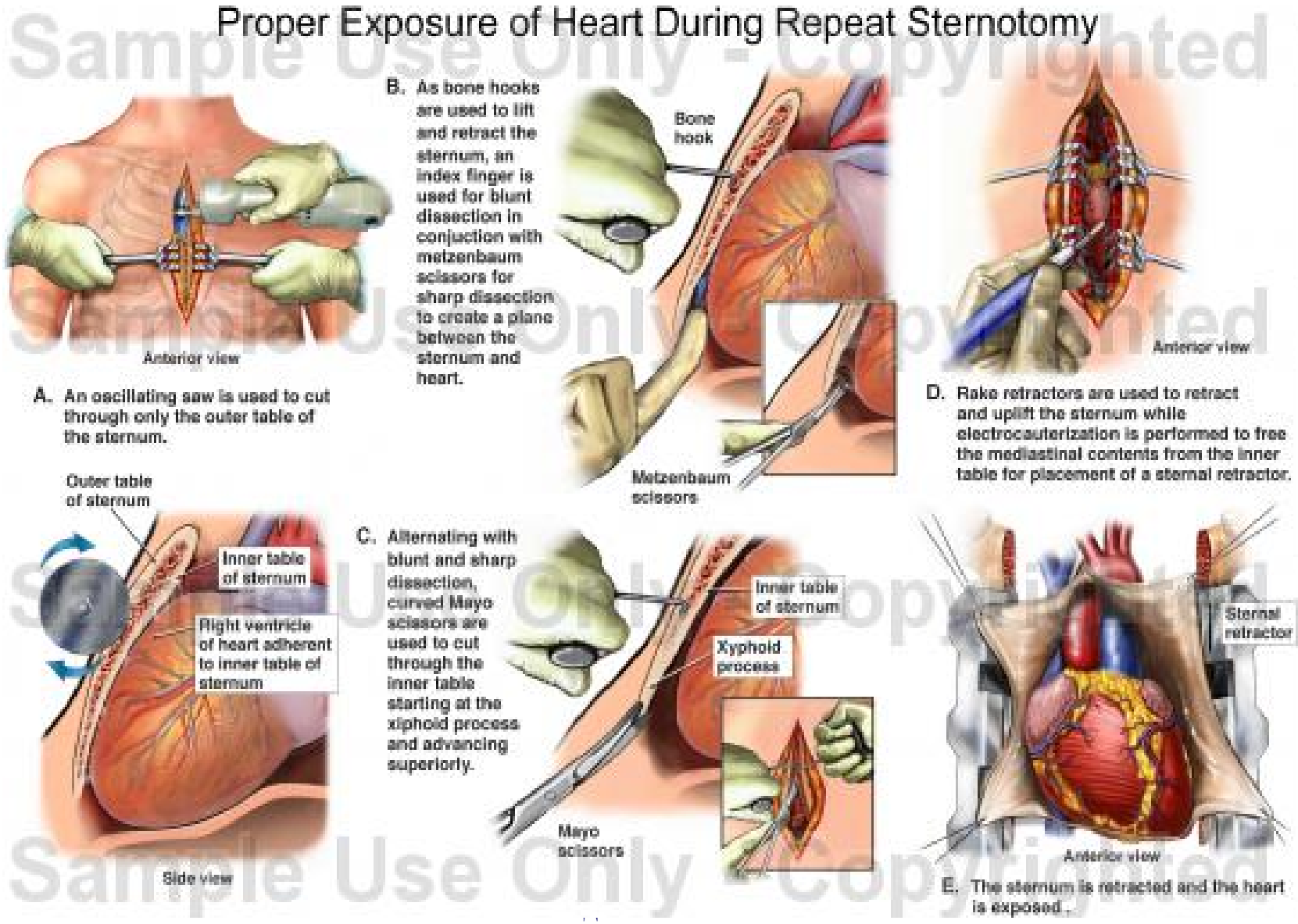
- Involves using small incisions between the ribs instead of using the traditional median sternotomy approach
- Usually done with the assistance of microscopic technology
- Usually done for patient with single vessel disease of the LAD that is not amenable to PTCA or stent
- During this procedure, the heart not stopped but the HR is reduced using B-blockers or Ca-channel blocker
- Special stabilization equipment is used to allow the surgeon to do the graft appropriately
- Usually, patient experience less surgical complications, less incisional pain, less hospitalization, and recovery more quickly

Off-pump Coronary Artery Bypass Surgery

- Beating heart surgery
- Usually, used minimal invasive direct coronary artery bypass grafting technique
- Used to reduce the neurological complication associated with the bypass machine
- Used for patient with low EF of the LtV

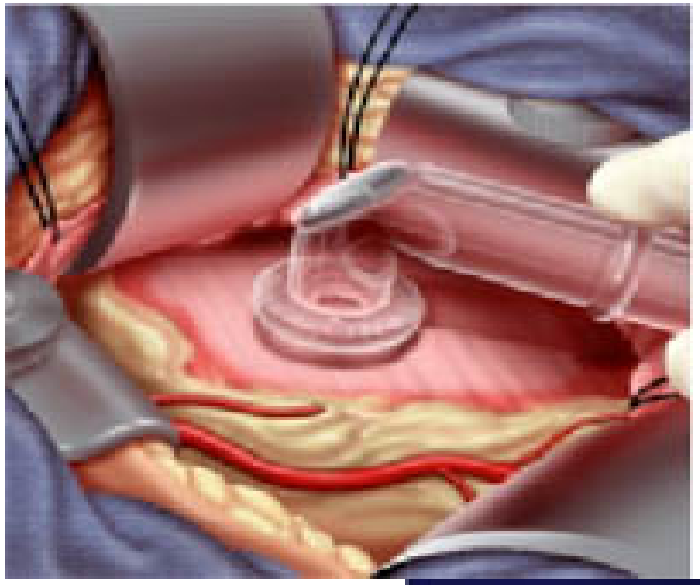


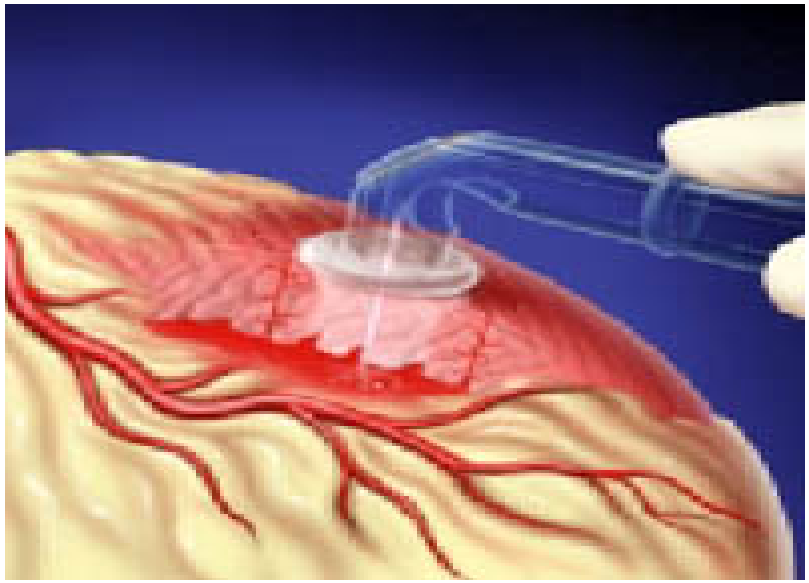
Median Sternotomy Approach

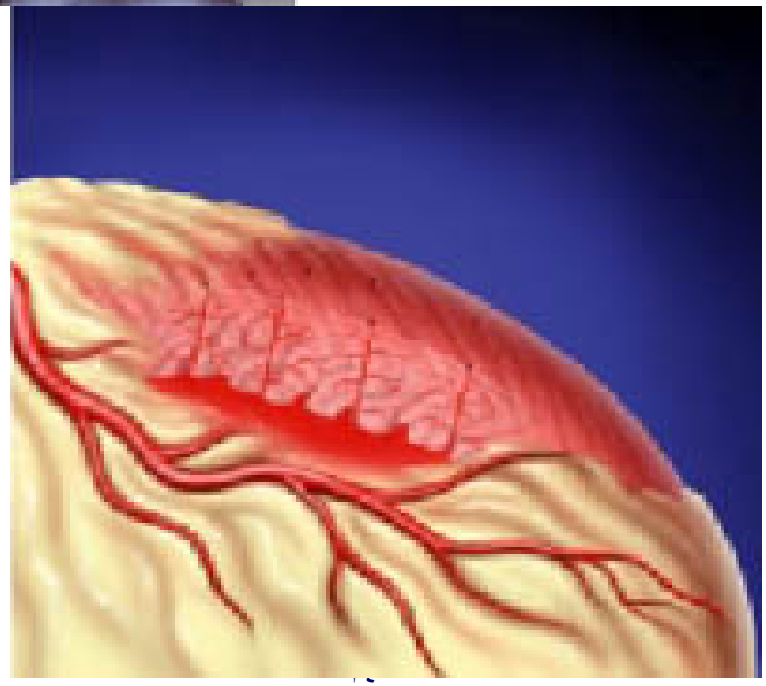


Transmyocardial Laser Revascularization

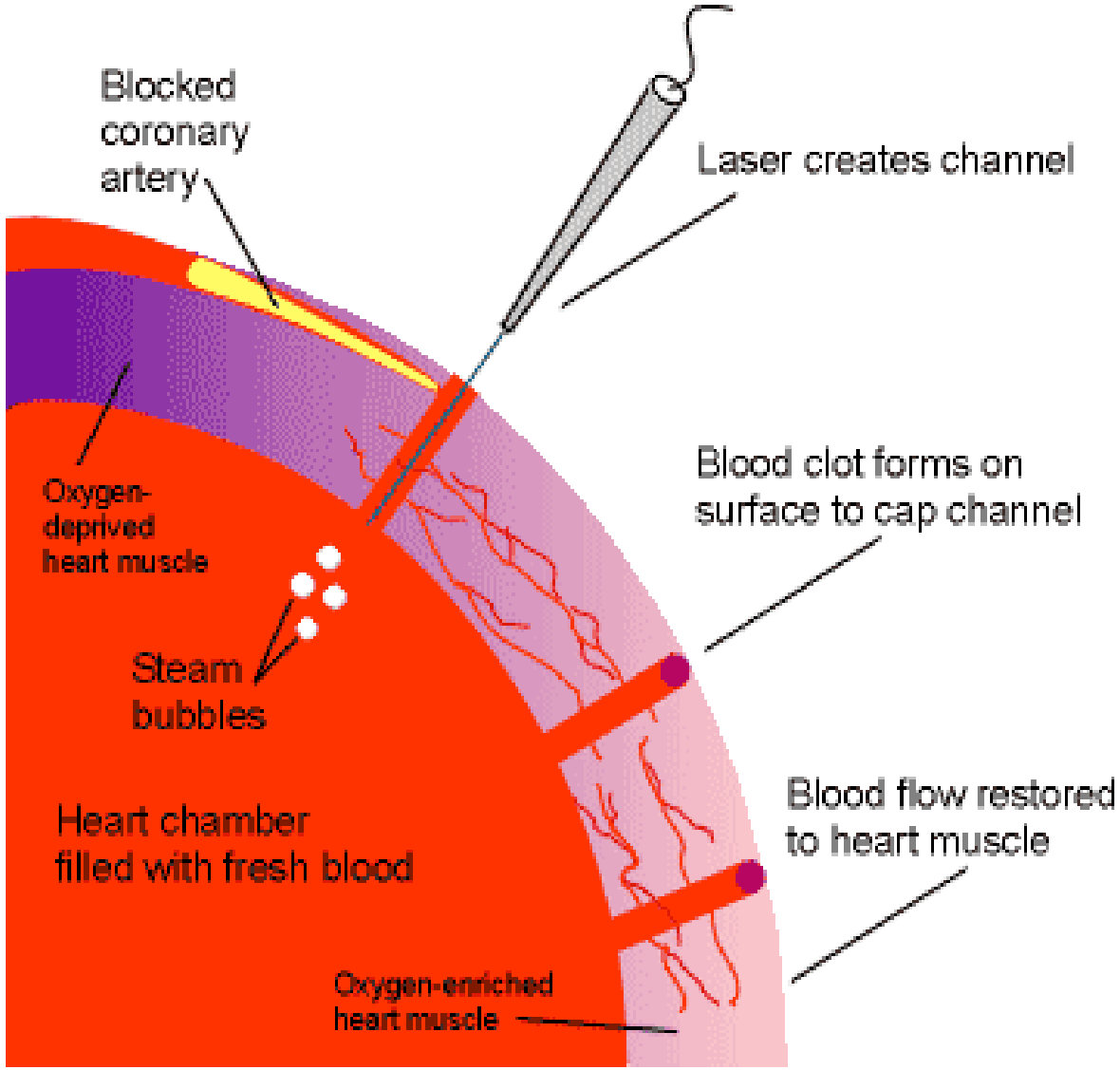
- Newly invented approach that include creating small channels through ischemic areas of the heart
- It is believed that these channels provide a means for blood to flow from the ventricle through the endocardium, the myocardium, and toward the epicardial surface of the heart
- It is also believed that these channels improve oxygenation of the myocardium through the angiogenesis
- Eligible patient
  - Unstable angina pain that refractory to intervention
  - Prior cardiac CABAG
  - Multiple cardiac intervention
  - Maximum medication treatment
- The outcomes of the procedure looks good and improvement of pain and activity was reported







Transmyocardial laser revascularization



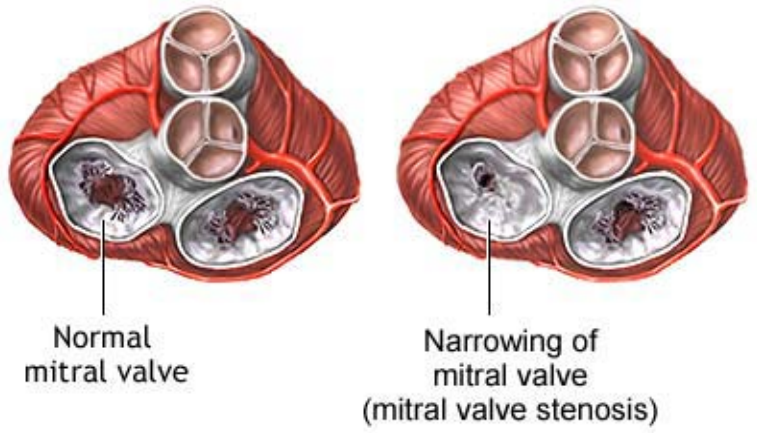
TMLR

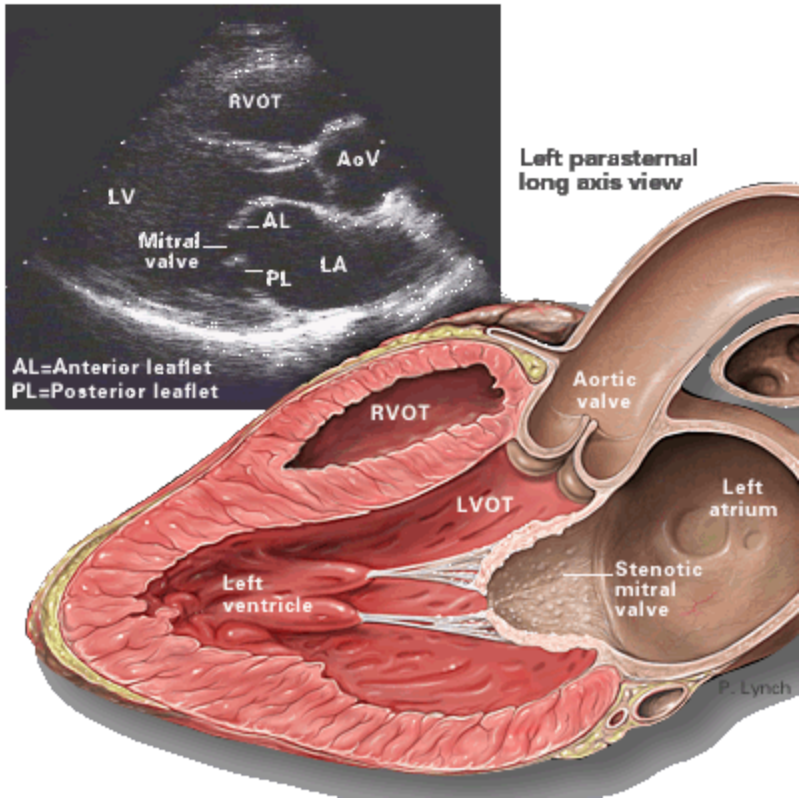
Valvular Disease

- Valvular stenosis
  - Narrowed orifice that creates a partial obstruction of blood flow
- Valvular insufficiency or regurgitation
  - Valve is incompetent or leaky blood flow backward
- Diagnosis
  - Health history
  - Murmur
  - Physical examination
  - Echocardiogram
  - Cardiac catheterization

Mitral Stenosis

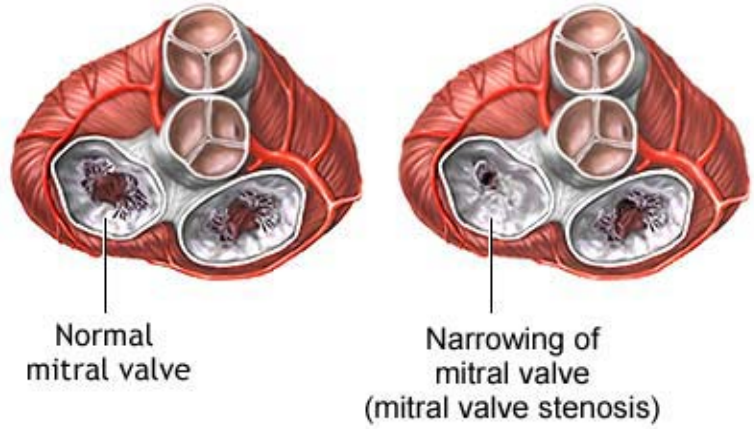
- Caused by rheumatic heart disease
- Because of narrowing of the valve → ↓blood flow from Lt atrium to Lt ventricle →↓cardiac output →↓ systemic perfusion →back flow to pulmonary circulation → pulmonary hypertension → pulmonary edema → dyspnea, orthopnea
- Lt atrial dilation cause atrial fibrillation in 40% - 50% of affected patient

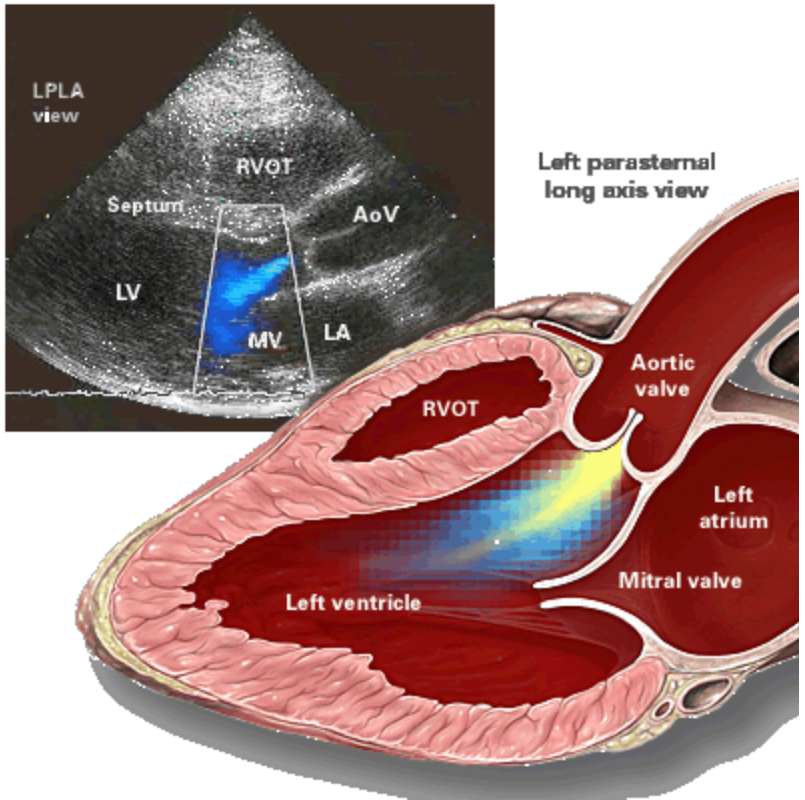




Mitral Insufficiency

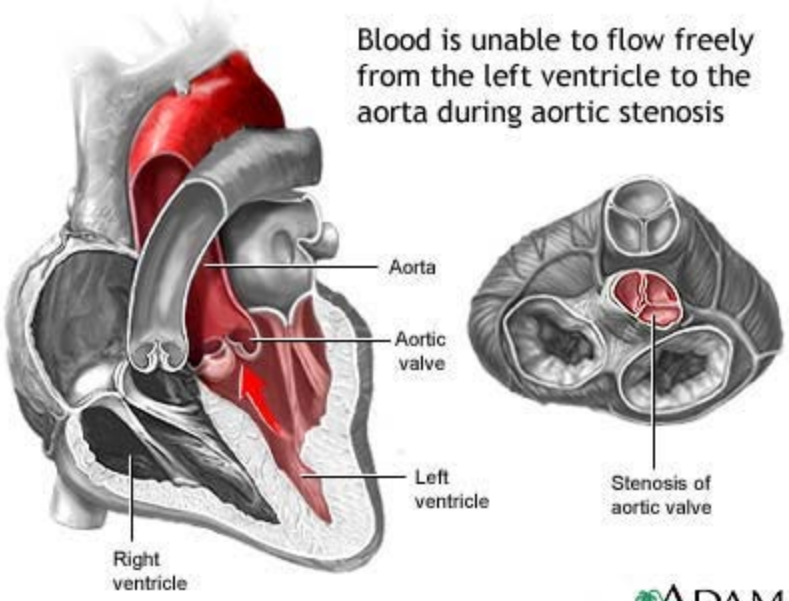
- Caused by rheumatic heart disease, degenerative changes
- Because of stretching of the leaflets of the valve → blood flow from LtV to Lt atrium → LtV hypertrophy → LtV overload →back flow to pulmonary circulation → pulmonary hypertension → pulmonary edema → dyspnea, orthopnea

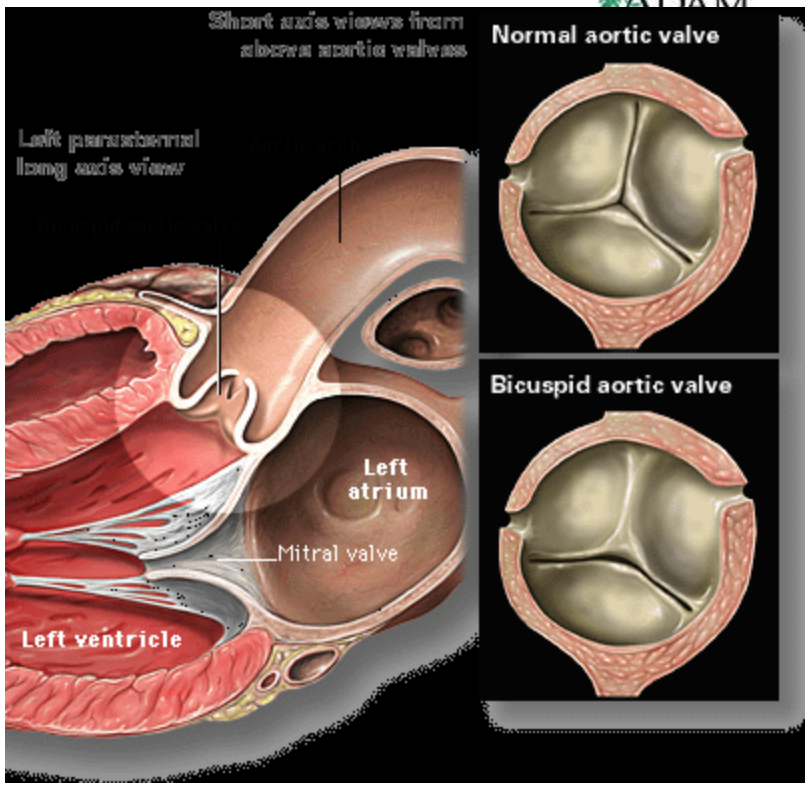




Aortic Stenosis

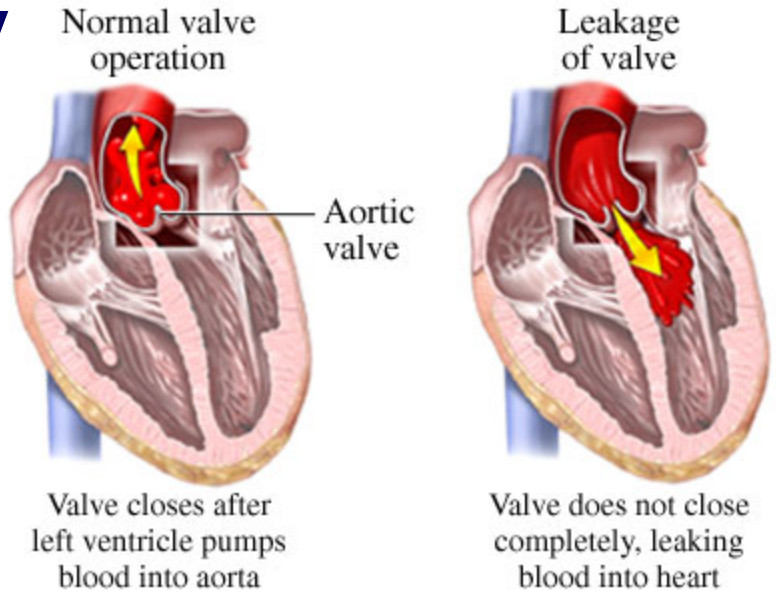
- Caused by rheumatic heart disease, bicuspid valve, or calcification degeneration
- Because of narrowing of the valve → ↓blood flow from LtV systemic circulation → angina and syncope
- Sever stenosis will lead to LtV hypertrophy and increased Intraventricular pressure
- Late stage they complain of dyspnea, orthopnea

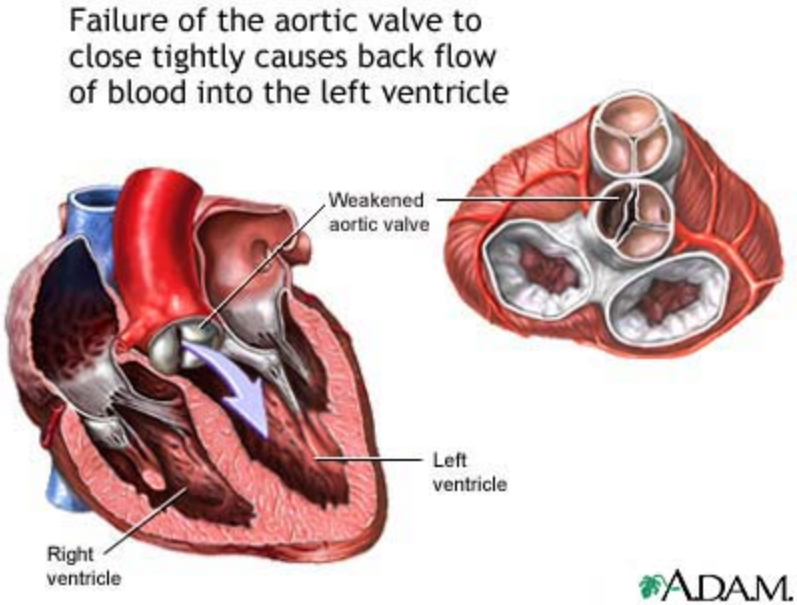




Aortic Insufficiency

- Caused by rheumatic heart disease, aneurysm of the ascending aorta
- Because of incomplete colure of the valve → blood flow from the aorta into the LtV during the diastole →↓forwar output and ↑ LtV pressure and volume →back flow to pulmonary circulation → pulmonary hypertension → pulmonary edema → dyspnea, orthopnea
- Patient usually have ↓diastolic pressure and wide pulse pressure
- Angina may occure





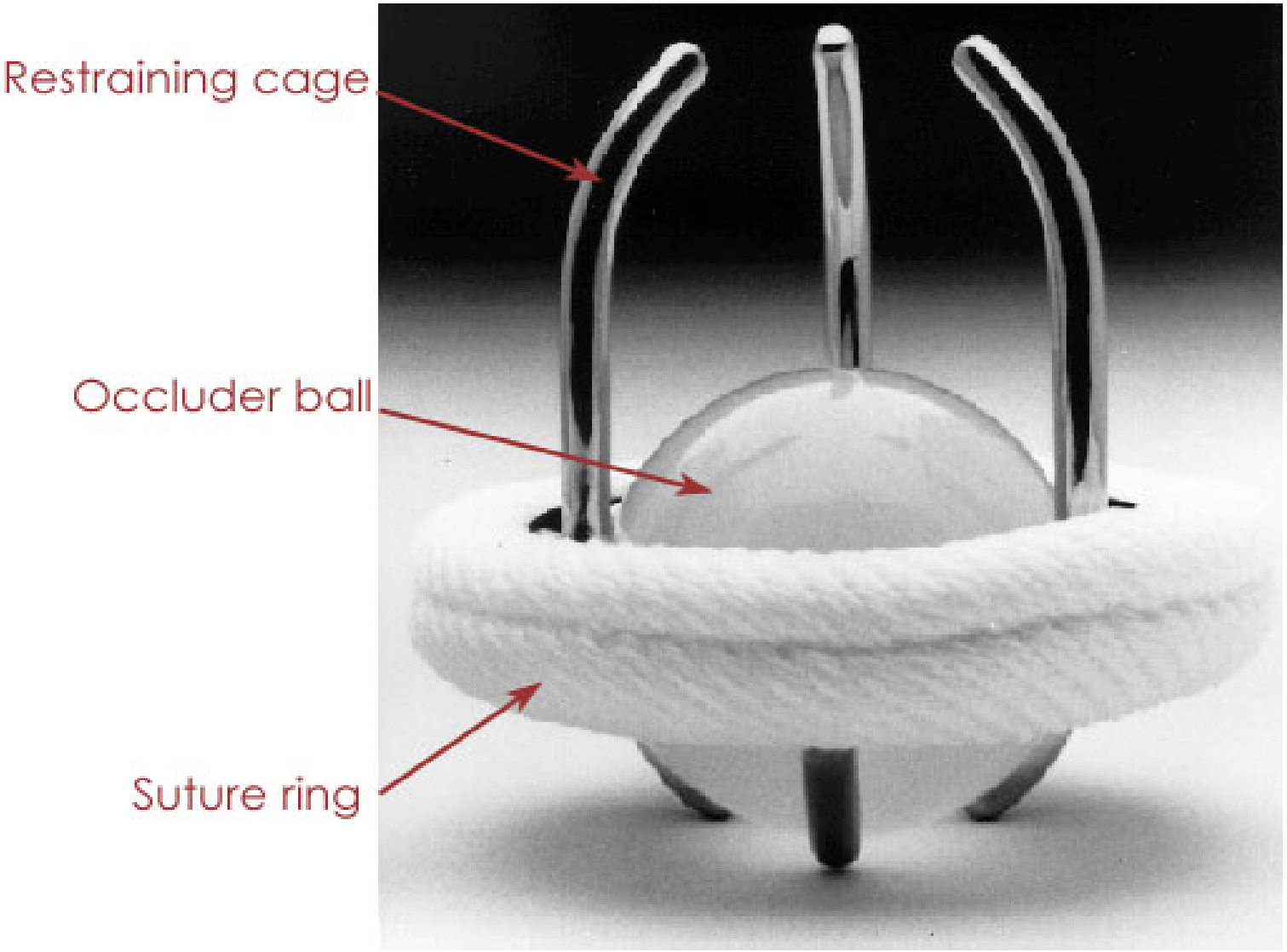
Cardiac Valve Surgery

- Cardiac valve diseases are mainly caused by rheumatic heart disease, degenerative disease, or endocarditis
- Lt heart valves are diseased more (aortic valve & mitral valve) than the Rt side
- This is because of greater pressure on the Lt side of the heart
- Surgery is indicated when symptoms of ventricular dysfunction start to appear

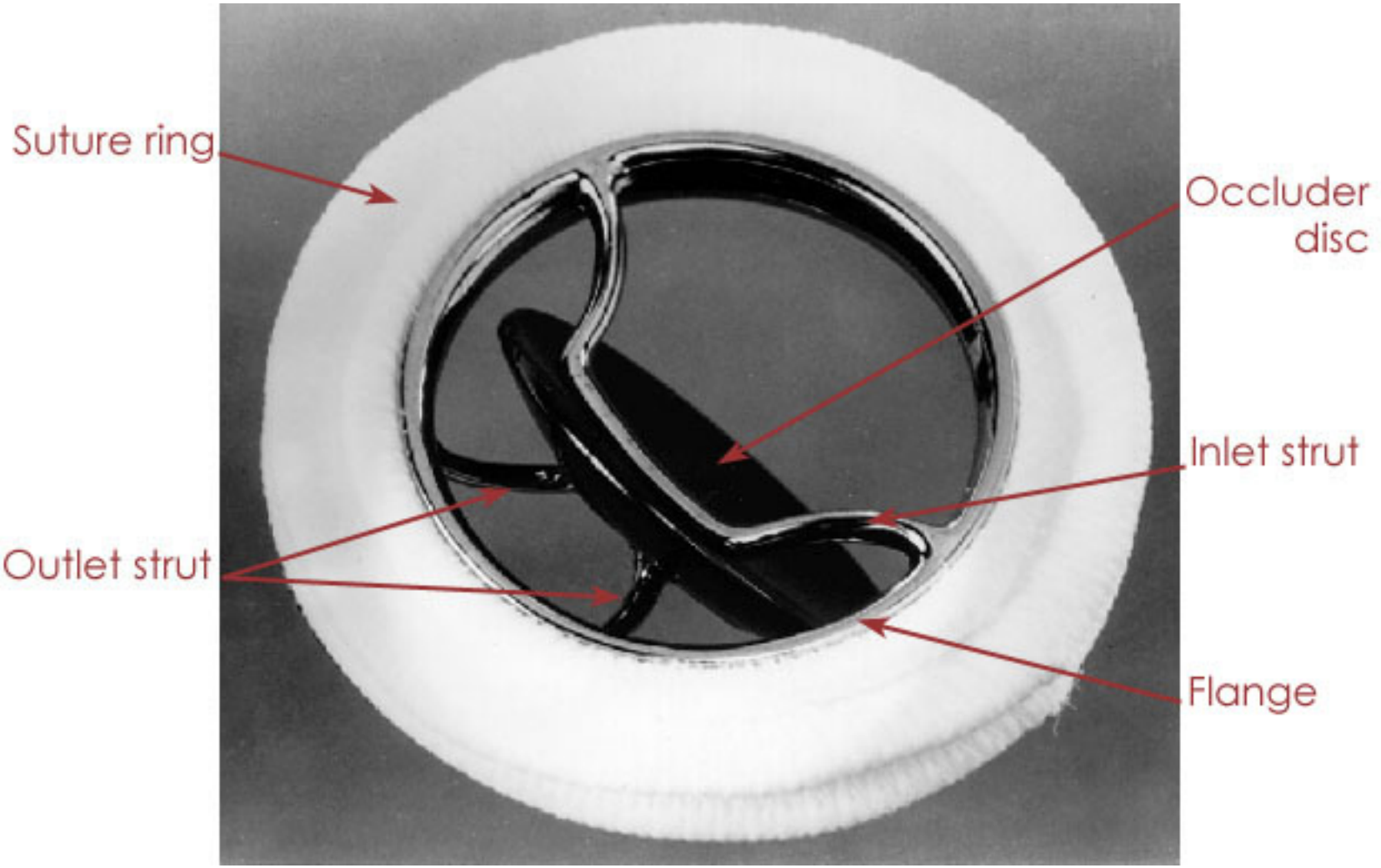
Cardiac Valve Replacement

- 2 types of valves are used:
  - **1. Mechanical valves**
  - They need lifelong anticoagulant therapy
    - Caged ball design
    - Tilting disc design
      - Single disc design
      - Bileaflet valve design

Caged ball design



Single disc design



Bileaflet valve design

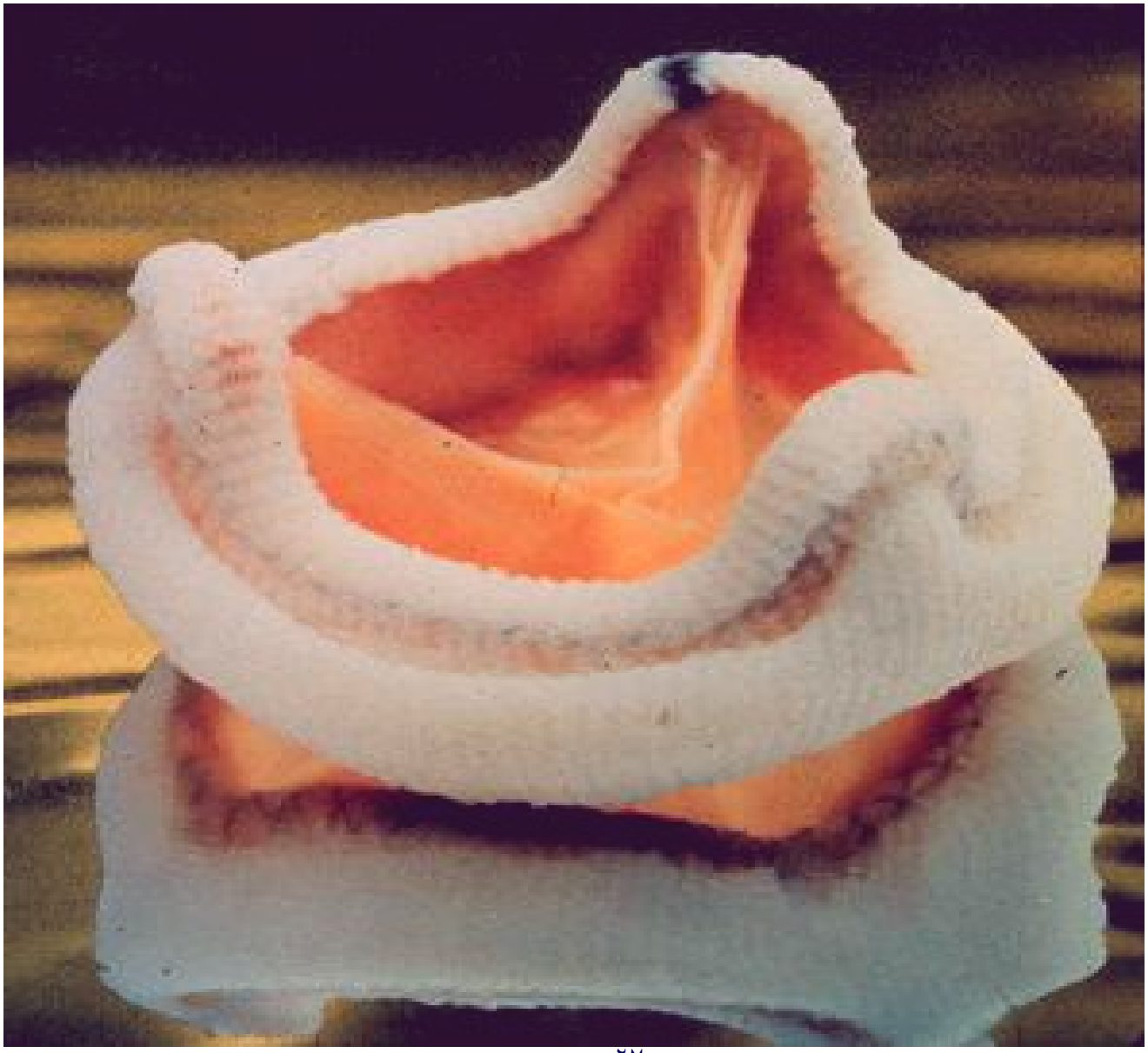
Cardiac Valve Replacement

2. Bioprosthetic valves

- Usually used for elderly
- Durable for 7 – 14 years
  - Porcine: pig aortic valve
  - Bovine: constructed from pericaridal tissue of calves
  - Homografts: valves retrieved from human heart within 24hrs of cardiac arrest

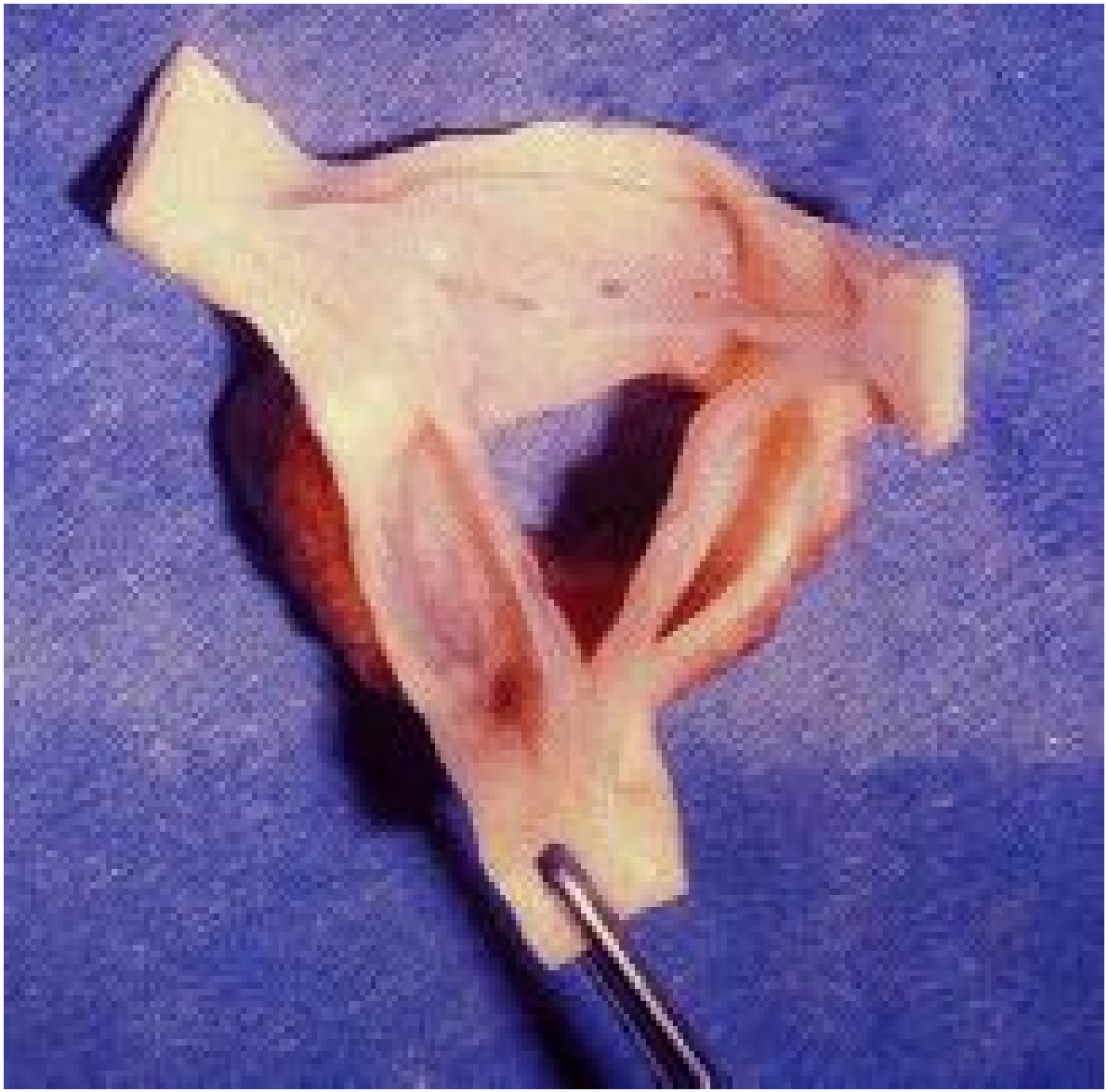
- The patient, cardiologist, & the surgeon determine the type of the valve based on location of the valve, age, lifestyle, past medical history
- Mechanical valves are selected if a long life expectancy is likely (e.g., > 15 years)

Porcine: pig aortic valve



Bovine aortic valve

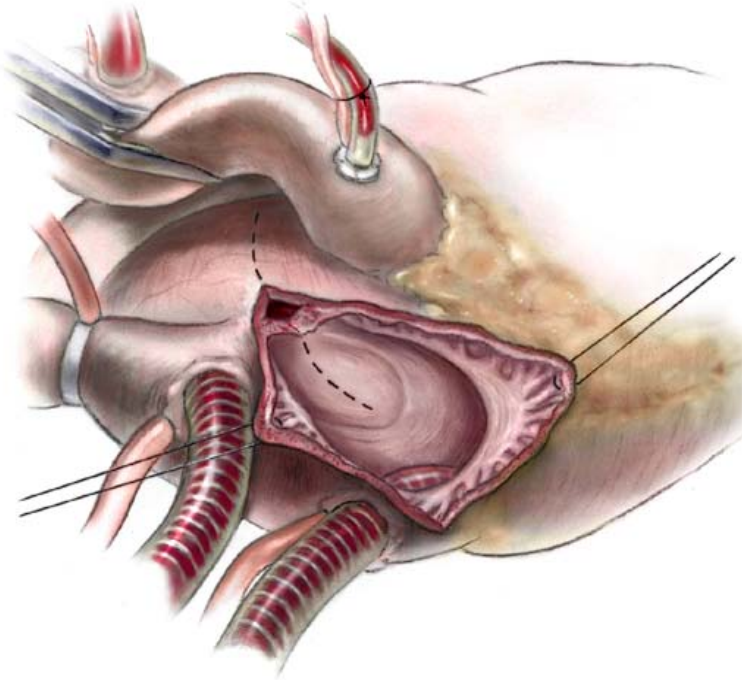
Allograft, a human aortic valve

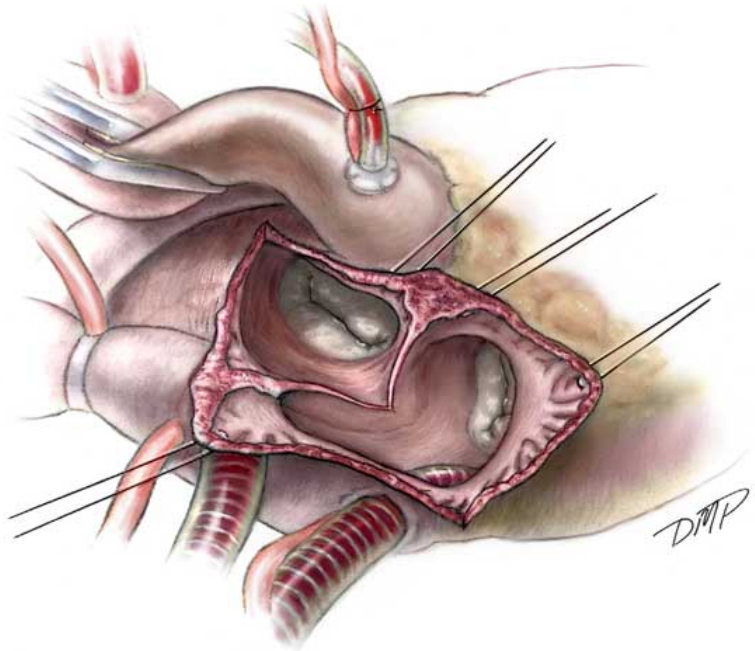


Cardiac Valve Repair

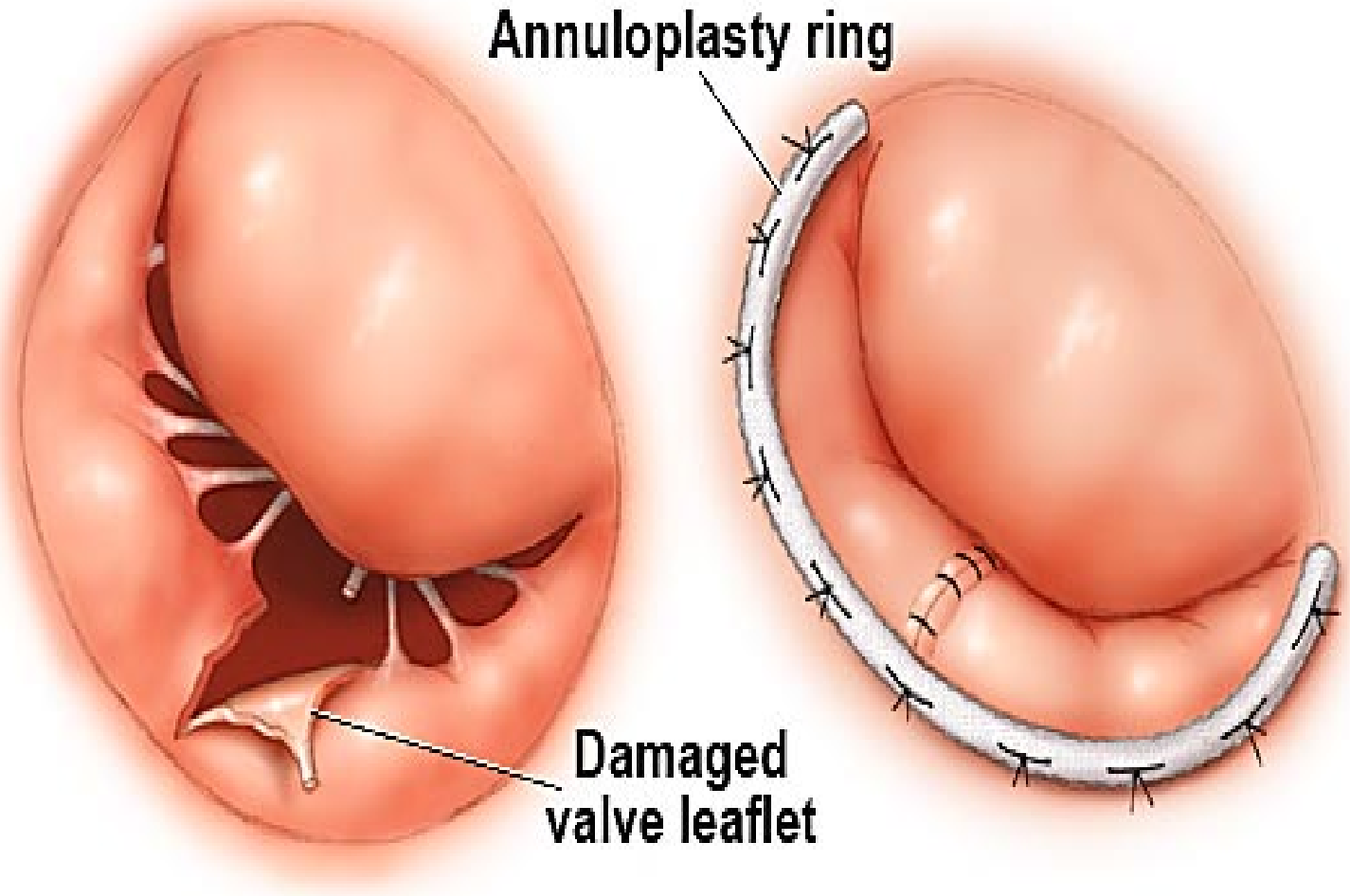
- Repair can be done for valve insufficiency or stenotic valves
- Mostly done for valve insufficiency
- Insufficient valve can be repaired by inserting an annuloplasty ring; the ring is sewn to the valve annulus this procedure → called valve annuloplasty
- Tears in valve leaflets can be patched with pericardial tissue
- Ruptured papillary muscle can be reattached to the ednocardium
- 80% of Mitral valve dysfunction can be repaired compared to small percentage for aortic valve

The right Atriotomy

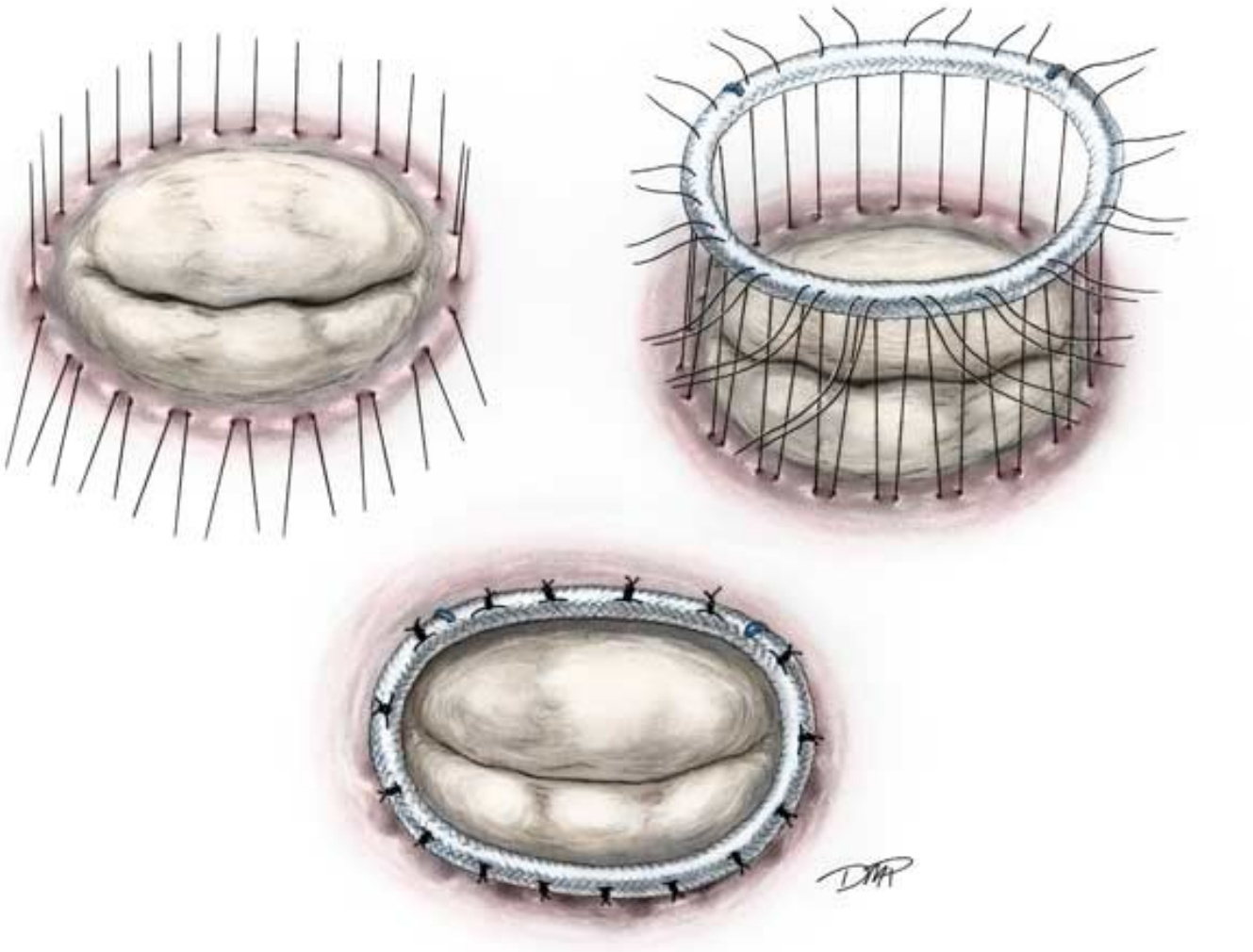




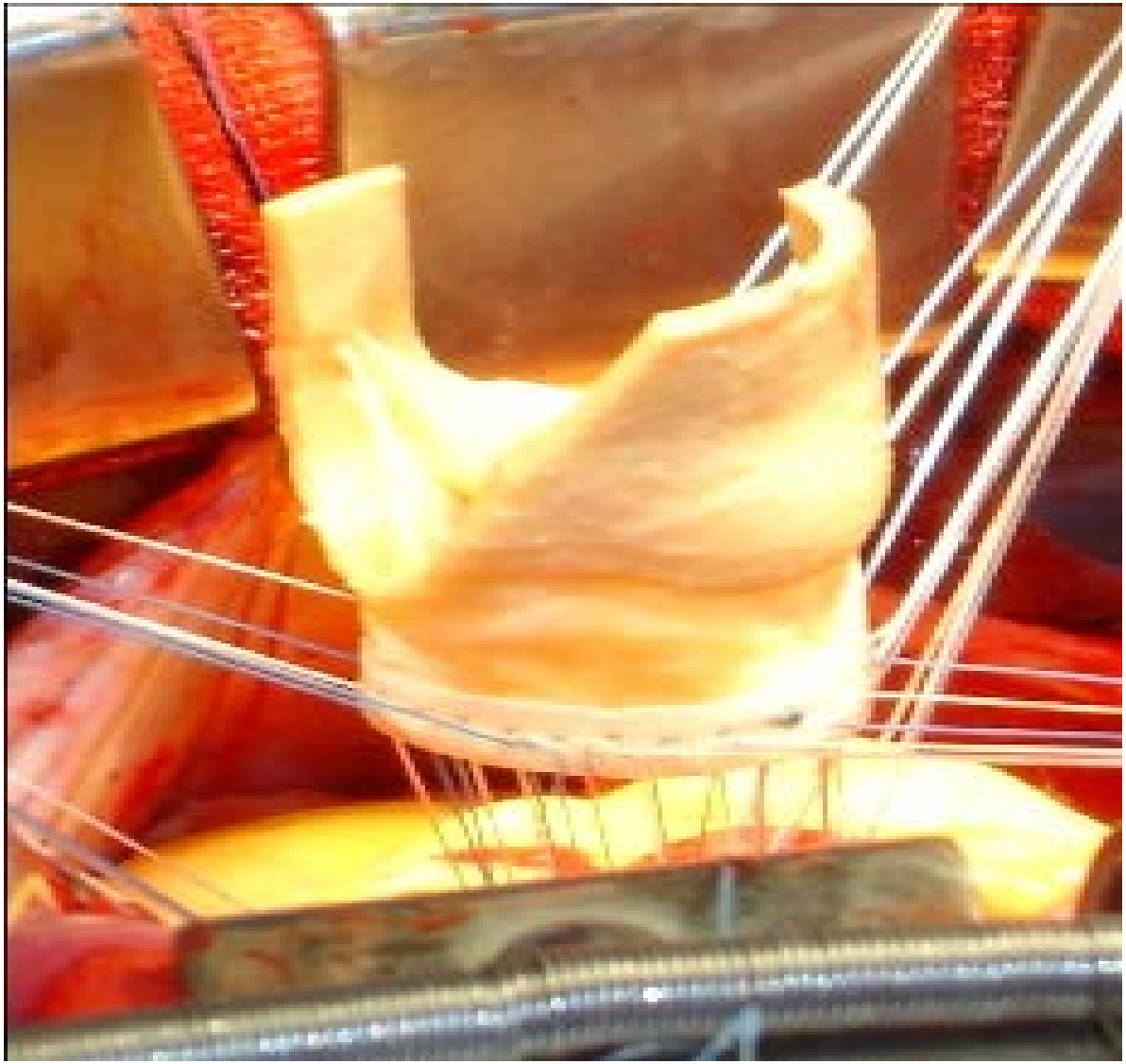
Annuloplasty



A ring annuloplasty



Valve Replacement and Repair



Preoperative Phase

- Patient and family need special preparation to decrease level of anxiety
- Educational preparations
  - Tour of the ICU waiting room, intermediate care unit
  - Have the patient talk and communicate with other patients recovering from the same surgery
  - Expectation before the surgery:
    - Diagnostic test
    - Skin preparation
    - NPO at least 8 hrs
    - Deep breath & coughing exercise, leg exercises
  - Expectation during the surgery
    - Expected time of the surgery
    - Type of the procedure
    - Family waiting room

Preoperative Phase

- Expectation after the surgery:
  - Name and location of the ICU
  - External devices such as ventilator, NGT, ECG electrodes, central lines, chest tubes, & foley catheter
  - Expected procedures such as endotracheal suctioning, blood administration, activity progression
  - Expected ICU noise & family involvement

- Additional preparations include
  - Results of preoperative laboratory test should be within normal range (e.g., blood chemistry, CBC, PT, PTT, ECG, chest x-ray, blood type)
  - Shower with antibacterial soap
  - Essential medication may be given early morning

Nursing Diagnoses

- **Preoperative phase**:
  - Anxiety
  - Knowledge deficit
- **Intensive Care Phase**
  - Pain
  - Decreased cardiac output
  - Fluid volume deficit
  - Alter breathing pattern
  - Infective family coping
- **Intermediate care phase**
  - Ineffective airway clearness
  - Pain
  - Decrease cardiac output
  - Activity intolerance
  - Knowledge deficit

Collaborative Management

- **Intraoparative phase**:
  - Several large IV access is established
  - ECG electrodes are placed
  - Central line & arterial line, foley catheter, endotracheal tube are inserted
  - Skin cleansed with povidone-iodine
  - Patient's sternum is opened at the same time saphenous vein is exposed
  - Cannulation of the Rt atrium & Aorta and attached to the cardiopulmonary bypass machine
  - Cardiopulmonary bypass machine oxygenates the blood and return it to the body
  - Machine is usually primed with balanced electrolyte solution

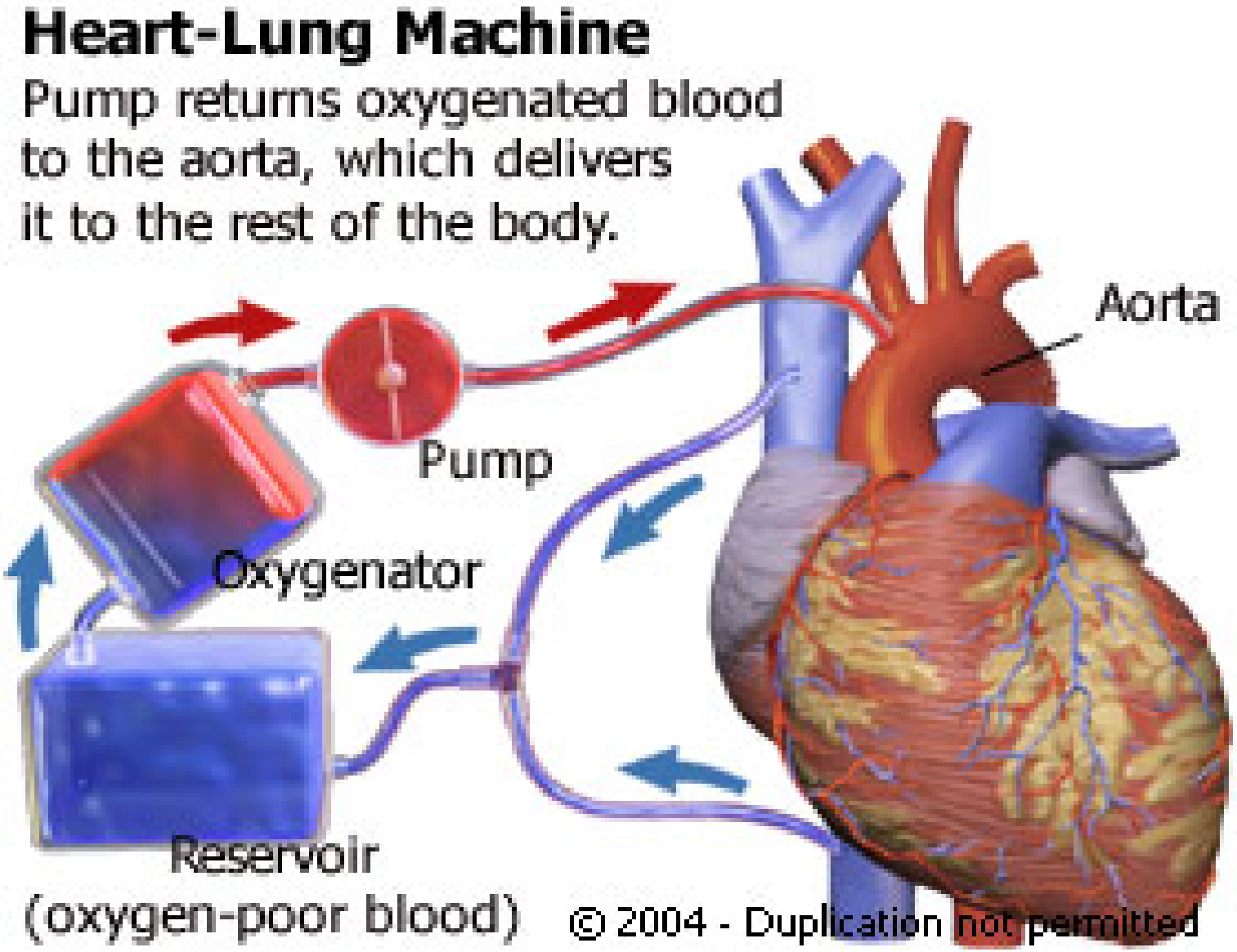
Collaborative Management

- **Intraoparative phase**:
  - Heparin is administered throughout the bypass machine
  - Core body temperature is reduced to 28-32Cº
  - Each 1Cº decreases 7% of the metabolic demands
  - Heart is arrested with cooled cardioplegic solution
  - Heart temperature reached 4Cº and stopped by injection of high concentrated K solution at the root of aorta
  - Cardioplegia solution is injected either continuously to aortic root or 15-30min or whenever the cardiac activity is resumed
    - Post operative cardiac depression
    - Arrhythmia
    - Decrease cerebral perfusion
    - Irreversible platelets dysfunction

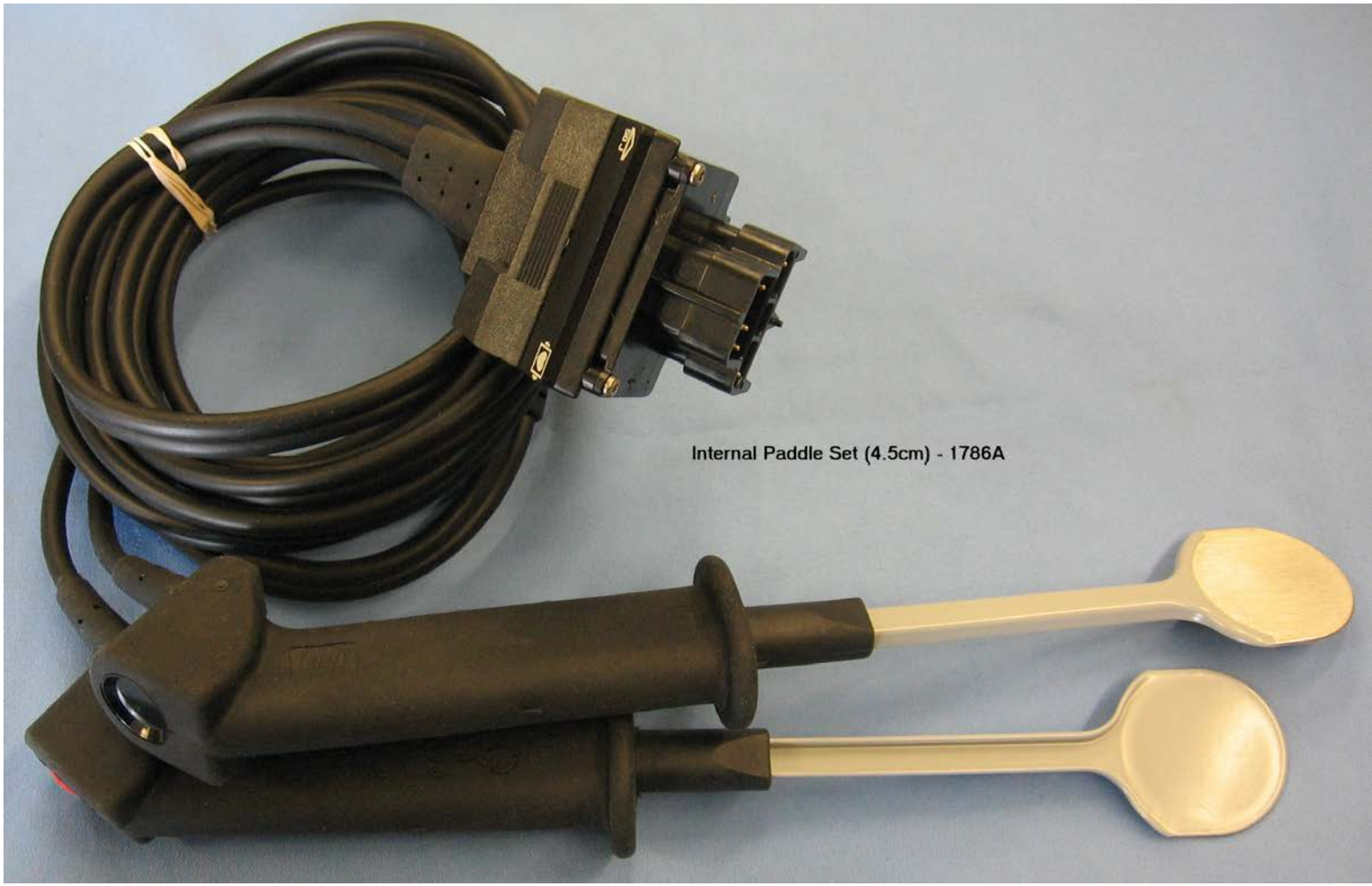
Collaborative Management

- **Intraoparative phase**:
  - New techniques used normothermic blood cardioplegia with or without core body temperature reduction
    - Less post operative bleeding
    - Better post operative LFV function
    - More frequent spontaneous return of normal sinus rhythm
  - Surgeon starts the operation while the heart is arrested
  - Heprinzation is reversed by protamin sulfate
  - Chest tube is placed mediastinum and pericardial
  - When the surgery is completed machine is removed and heart activity is resumed

Cardiopulmonary bypass machine



Cardiopulmonary bypass machine


Internal Paddle Set (4.5cm) - 1786A

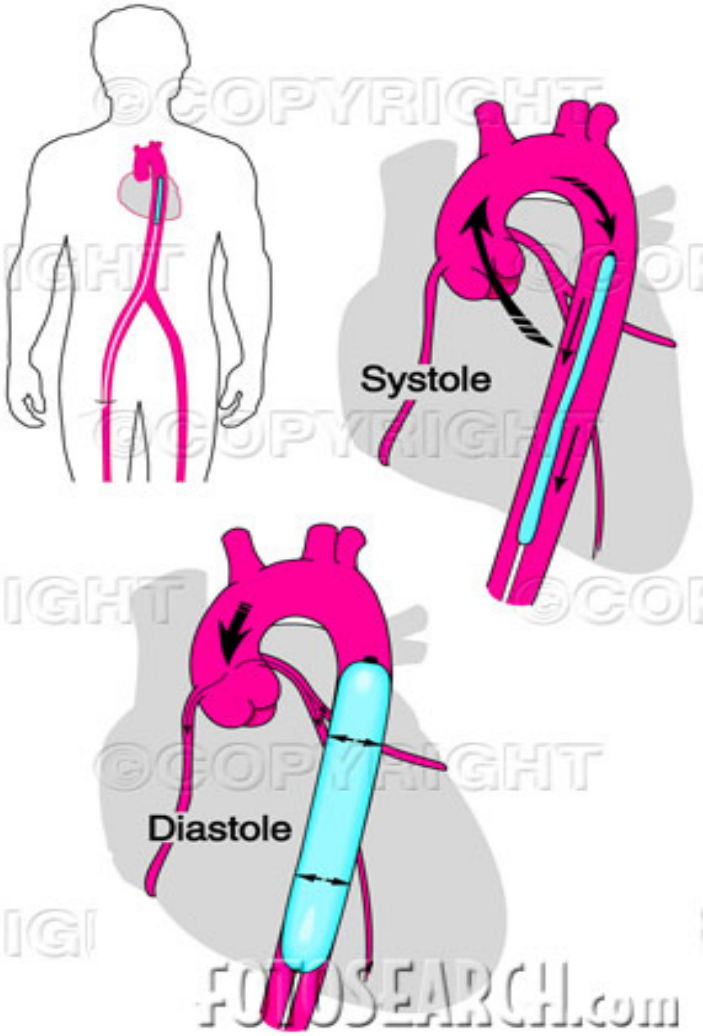
Collaborative Management

- Postoperative ICU phase:
  - Usually need 2 nurse for the first 30 – 45 min
  - Initial VS, cardiac rhythm, hemodynamic parameters, chest tubes outputs are recorded
  - Neurologic status:
    - Pupils reaction
    - Consciousness
    - Orientation
  - Ventilation and oxygenation
    - Patients usually intubated and mechanically ventilated
    - Usually FiO2 at 50%, TV at 10 – 15 mL/Kg, RR at 10-12, PEEP can be added at low level
    - PSO2, ABGs are monitored
    - Endotracheal suction is done when necessary with hyperoxygenation and hyperventilation before the suction
    - Usually patient is extubated within 2-4 hrs
    - After extubation patient is paced on face mask 50% with semifowler position, then weaned to nasal cannula 6L
    - Incentive spirometry is encouraged at least 10 times per hr
    - Encourage deep breathing & cough exercise with pillow support over the incision

Collaborative Management

- Postoperative ICU phase:
  - Hemodynamic Monitoring
    - Fluid replacement is necessary to optimize preload
    - Intropes may be infused to enhance contractility
    - It is recommended to keep the mean arterial pressure between 65-75 mmHg for the first 12 hrs
    - Hypertension may be managed with nitorglycerin infusion
    - Right atrial pressure is maintained by fluid replacement
  - Mechanical Support
    - Intra-aortic balloon pump is usually inserted through the femoral artery
    - Usually timed by the ECG waveform to inflate during diastole & deflate during systole
    - It improve oxygenation and blood flow to sensitive organs such as brain, kidneys and heart
    - It acts by decreasing both the afterload and preload

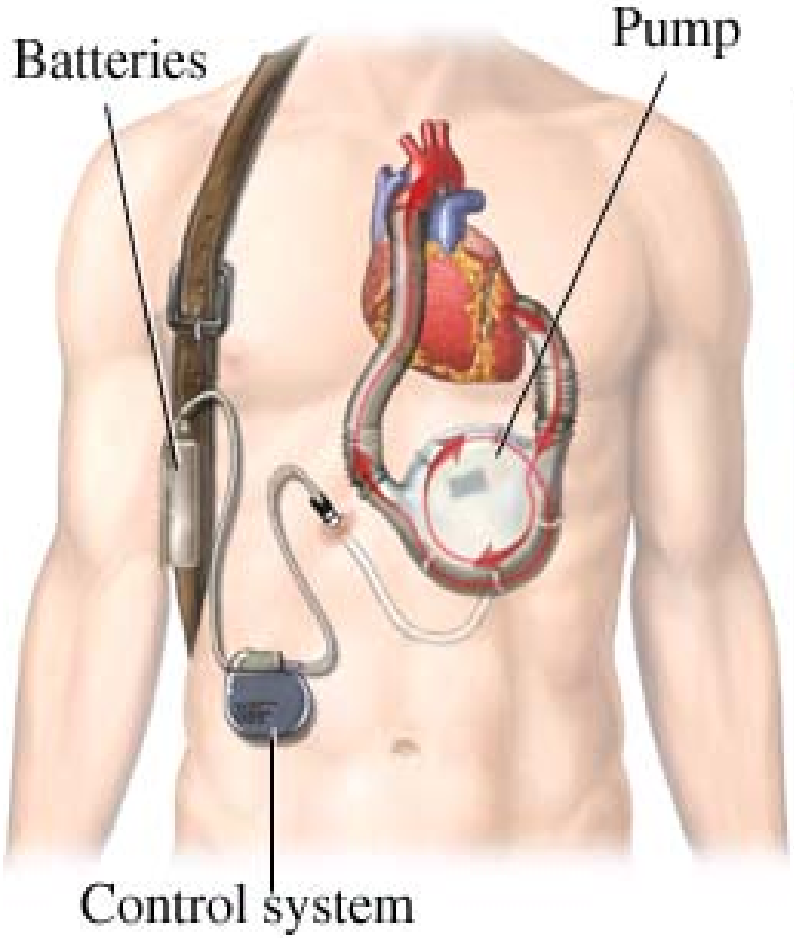
Intra-aortic balloon pump

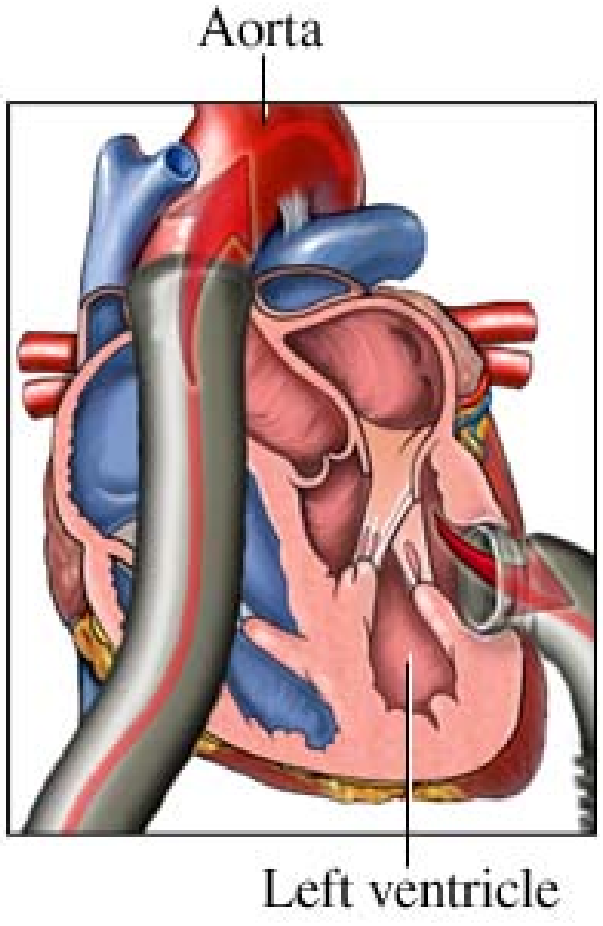


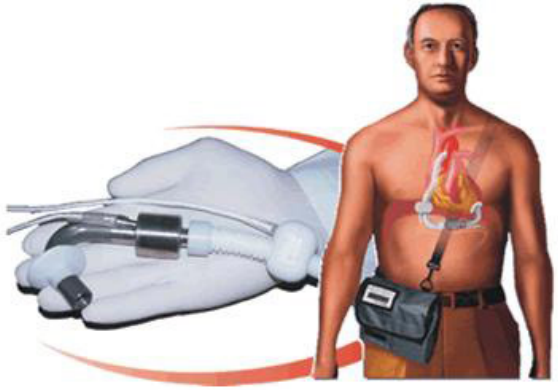
Collaborative Management

- Postoperative ICU phase:
  - Ventricular assist devices
    - Placed at the end of operation when the CO is severely altered and the intra-aortic balloon pump was not effective in maintaining adequate CO
    - Patient may receive Rt ventricular, or Lt ventricular, or biventricular assist devices
    - For Rt ventricular assist device, one port is placed in the Rt atrium and the other port in the pulmonary artery
    - Rt ventricular assist device assists the heart by divert the blood from the Rt ventricle to the pulmonary artery
    - For Lt ventricular assist device, one port is placed in the Lt atrium and the other port in the Aorta
    - Lt ventricular assist device assists the heart by divert the blood from the Lt ventricle to the Aorta
    - Biventricular assist device combines both

Ventricular assist device (VAD)







Collaborative Management

- Postoperative ICU phase:
  - Cardiac Rhythm
    - Potential causes of disturbances include electrolytes disturbances, hypothermia, edema of the conduction pathway or damage of the conductive pathway
    - Usually pacing wires are placed on the heart at the end of the procedure
    - Pacing wires can be used for temporary pacing in case of emergencies
    - Usually temporary pacing is set on demand mode
    - Because the wires are contacted with the epicardium, precautions should be taken to avoid microshocks
    - In case of cardiac arrest temporary pacing is usually enough to establish a cardiac rhythm, if not CPR is started
    - CPR is done by reopening the chest quickly and do direct cardiac massage

Collaborative Management

- Postoperative ICU phase:
  - Fluid Status
    - Patients are commonly fluid depleted because of:
    1. Vasodilatation caused by releasing bradykinin & serotinin
    2. Fluid leaks into the interstitial tissue
    3. Blood loss
    4. Chest tubes drainage
    5. Post operative diuresis result from mild hyperglycemia
    - Hypovolemia is treated by infusion of Normal Saline or Ringer's lactate, or Hetastarch (Hespan)
    - Fluid amount is determined by the hemodynamic status of the patient
    - Chest tube drainage more than 200mL per hr should be reported directly to the surgeon
    - Consider blood transfusion if Hb less than 8mg/dL

Collaborative Management

- Postoperative ICU phase:
  - Restoring of Temperature
    - Patient are cooled by the heat exchanger to mild hypothermia to minimize metabolism cellular O2 requirements
    - Sever hypothermia can cause ventricular dysrhythmias, myocardial depression, ↑blood viscosity and systemic vascular resistance
    - Rewarming is started at the end of the procedure by covering the patient's head, thermal blankets, infrared lamps
    - If the patient developed sever shivering Morphine sulfate is given to reduce the side effect of shivering
    - Shivering increases the body's metabolic needs by 300 to 800% , CO2 production, HR, & systemic vascular resistance

Collaborative Management

- Postoperative ICU phase:
  - Renal Status
    - I & O is recorded
    - Urine output should be at least 0.5mL/Kg per hr
    - K level should be closely monitored
    - K replacement should be considered when K level less then 4.0 mEq/L
  - Pain
    - In side the **OR** Propofol (Diprivan) is given infusion at rate of 10 – 50 µg/Kg per min titrated gradually to allow the patient to wake up
    - Morphine sulfate is given for the first 24hr
    - Oral pain killer is usually prescribed
  - Activity
    - Turning position every 2 hrs
    - Setting the first day
    - Ambulation begins as soon as patient is free from hemodynamic monitoring lines

Collaborative Management

- Postoperative Intermediate Cardiac Care Phase:
  - Neurologic Status
    - Neurologic assessment every 8 hr
  - Cardiovascular
    - ECG monitoring for 3 – 5 days postoperatively
    - Atrial dysrhythmias are common (20 – 40%)
  - Pulmonary Status
    - Aggressive pulmonary care is needed to clear out the secretion
    - Incentive spirometry is encouraged ever hr
    - Medastinal or pleural chest tube can be removed in the ICU or in the intermediate unit when the output is less than 100mL/8hr

Collaborative Management

- Postoperative Intermediate Cardiac Care Phase:
  - GI Status
    - NGT is usually discontinued next day of the operation
    - If the gastroepiploic artery is used NGT is kept for 2 days
    - H2 blocker may be used
    - Liquids are allowed after extubation
    - Low-fat, cardiac diet is given when tolerated
    - Assess for constipation
  - Renal Status
    - I & O monitoring
    - Diuretics may be prescribed to mobilize interstitial fluids
    - K level should be monitored
  - Skin
    - Incisions should be assessed daily
    - Chest tube incision is covered by sterile dressing
    - Leg incision is kept until oozing is stopped
    - It is **NOT** recommended to clean the incision with NS if there is no need for that

Collaborative Management

- Postoperative Intermediate Cardiac Care Phase:
  - Infection
    - S & S of infection should be monitored
    - Antibiotics are given as needed
  - Activity
    - Patient is encouraged to gradually increase his daily activity
    - Stair climbing is initiated before discharge
    - Shoulder and arm exercises are started

Multidisciplinary Outcomes

- Maintaining adequate oxygenation
- Maintenance of hemodynamic stability
- Restoration of fluid and electrolyte balance
- Achievement of optimal activity level
- Maintenance of nutritional status
- Prevention of complication
- Self-management of therapeutic regimen

Questions and answers