NCA III Critical Care

Unit V

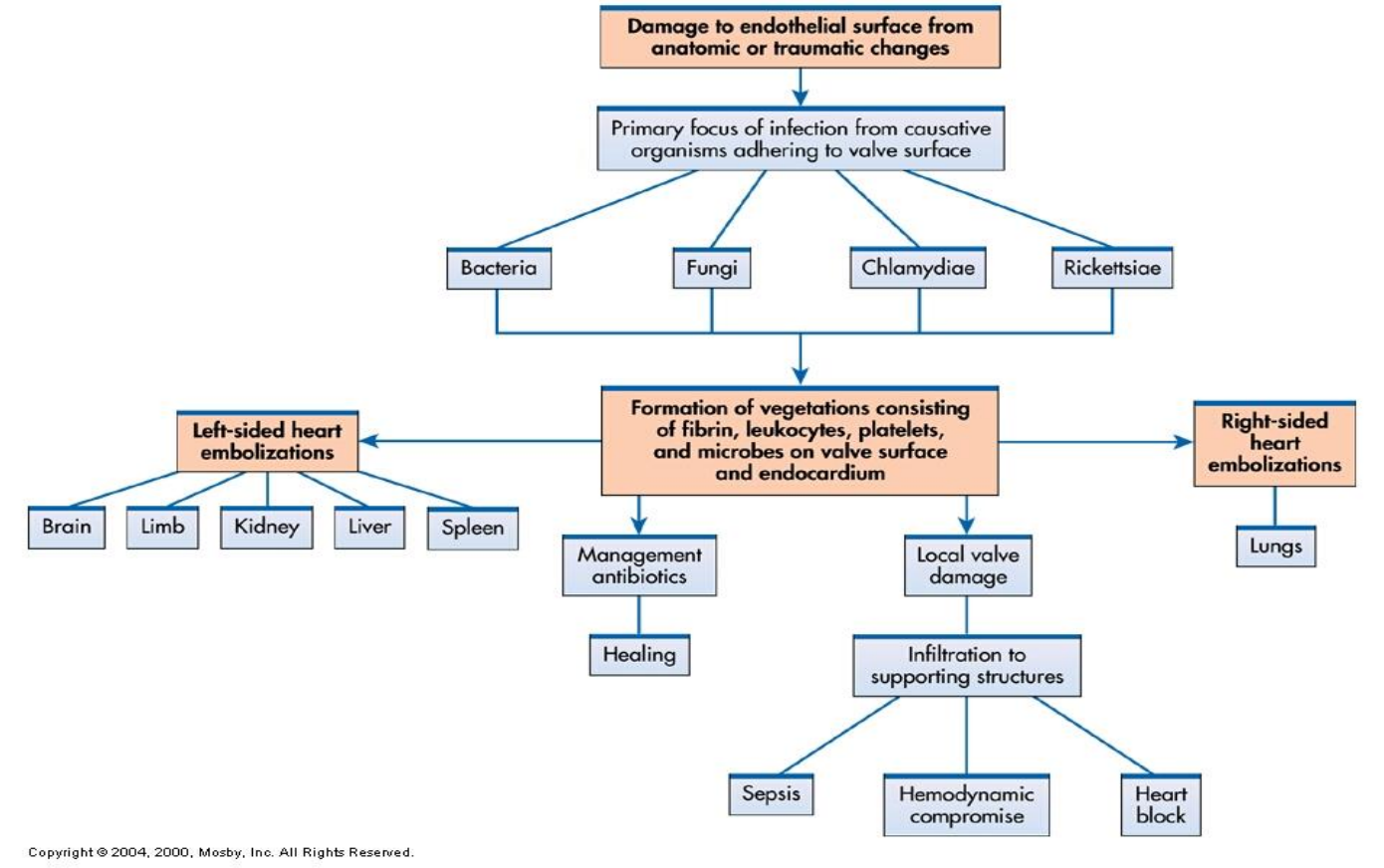
Infectious Diseases of the Heart

- Infective Endocarditis:
  - Definition: an infection of the inner lining of the heart caused by various organisms which can lead to deformity of the valve leaflets.

Infectious Diseases of the Heart

- Infective Endocarditis:
  - Etiology:
    - Infective agents:
      - Bacteria
      - Fungi
      - Rickettsiae
    - Inflammation
    - Clot formation
    - Emboli

Infectious Diseases of the Heart

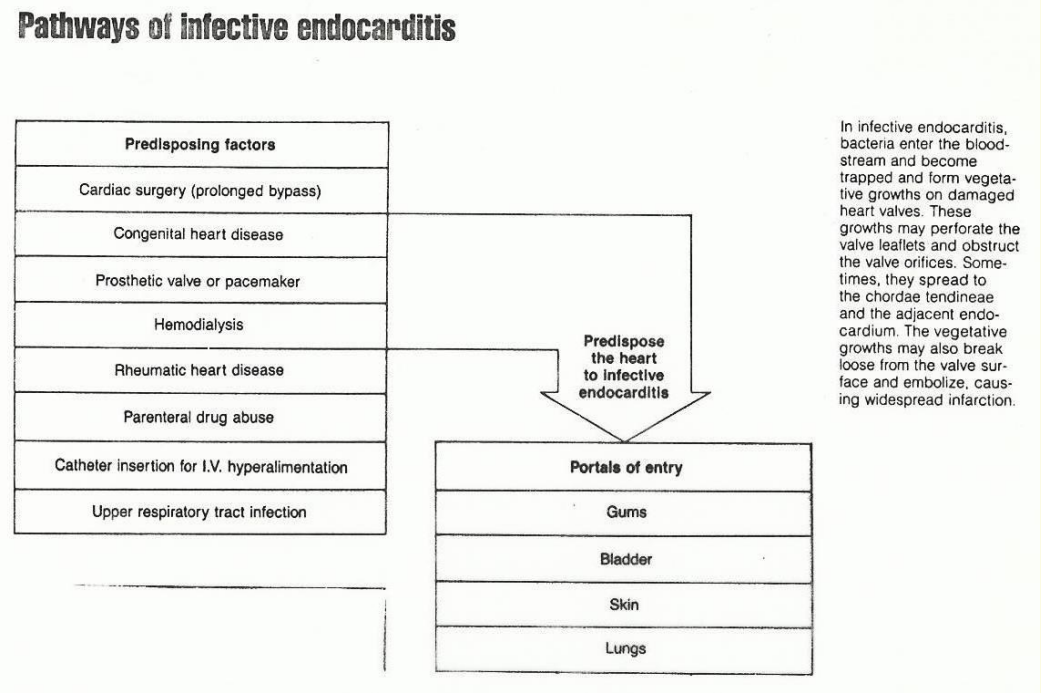


Infectious Diseases of the Heart

- Infective Endocarditis:
  - Etiology:
    - Valve deformity or malfunction
    - Acute or subacute
    - High incidence:
      - Artificial valves
      - Congenital heart disease
      - Drug abusers
      - Immunocompromised persons
      - Indwelling invasive lines

Infectious Diseases of the Heart

- Infective endocarditis:
  - Portals of entry



Infectious Diseases of the Heart

- Infective Endocarditis:
  - Signs and symptoms:
    - Signs of embolic phenomenon may be the initial symptoms-damage already done
    - Fever
    - Chills
    - Sweats
    - Anorexia
    - Weight loss

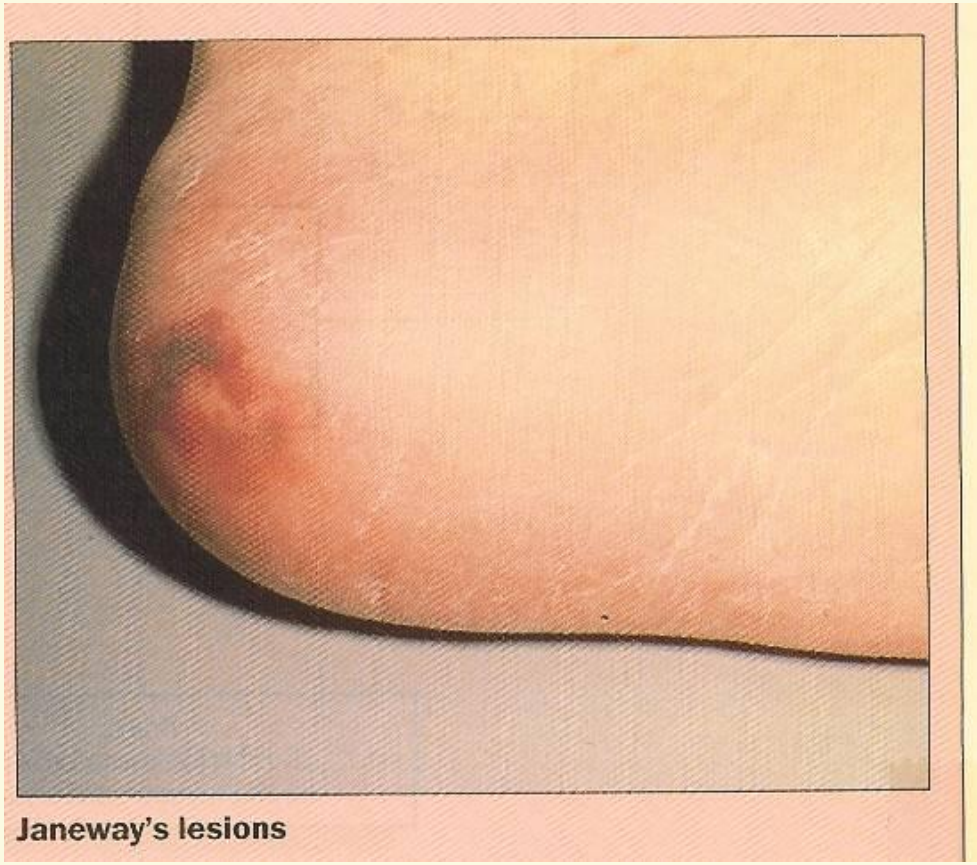
Infectious Diseases of the Heart

- Infective Endocarditis:
  - Signs and symptoms:
    - Weakness
    - Cough
    - Back and joint pain
    - Petechia
    - Splinter hemorrhages
    - Osler’s nodules
    - Janeway’s lesions

Infectious Diseases of the Heart

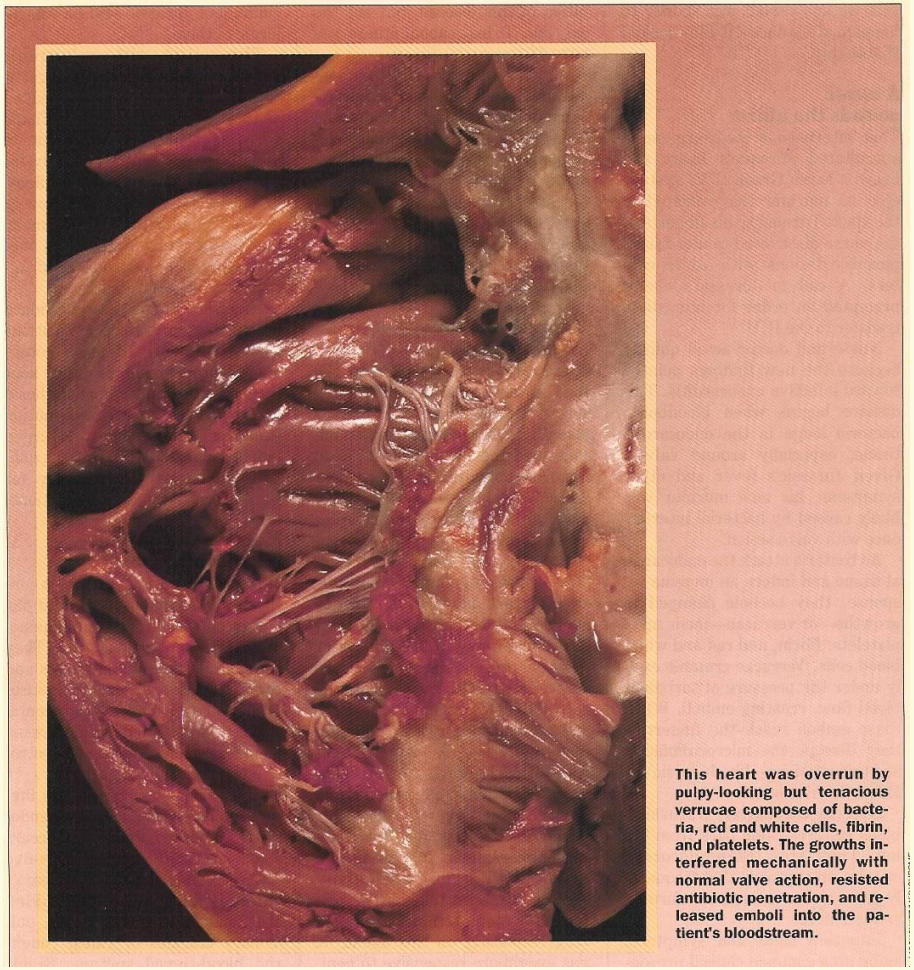
Splinter hemorrhages

Valve Diseases



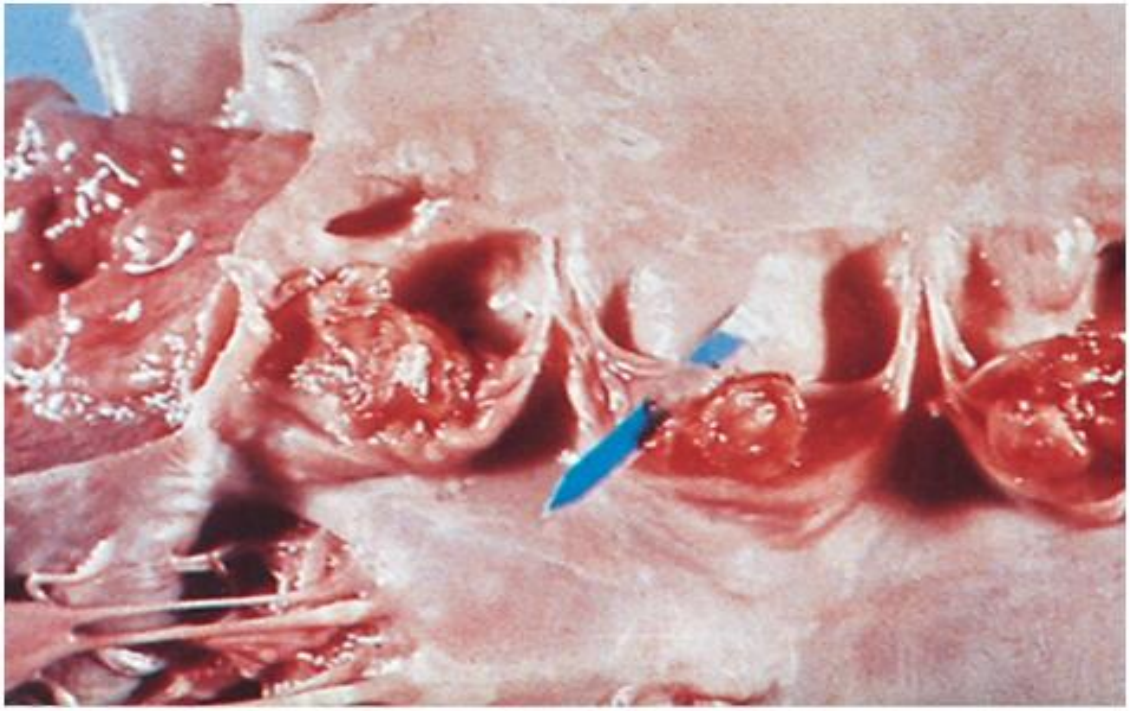
Janeway's lesions

Infectious Diseases of the Heart



This heart was overrun by pulpy-looking but tenacious verrucae composed of bacteria, red and white cells, fibrin, and platelets. The growths interfered mechanically with normal valve action, resisted antibiotic penetration, and released emboli into the patient's bloodstream.

Infectious Diseases of the Heart



From Kissane JM: *Anderson's pathology*, ed 9, St. Louis, 1990, Mosby.

Infectious Diseases of the Heart

- Infective Endocarditis:
  - Management:
    - Diagnostic:
      - History and exam
      - Blood cultures
      - Echocardiogram

Infectious Diseases of the Heart

- Infective Endocarditis:
  - Management:
    - Treatment:
      - Antimicrobials based on culture
      - Repeat blood cultures
      - Supplemental nutrition
      - Surgical intervention
      - Drainage of abscesses

Infectious Diseases of the Heart

- Infective Endocarditis:
  - Management:
    - Evaluation:

How would the nurse evaluate whether or not treatment for infective endocarditis is effective?

1. Few fine crackles in bases
2. Temp 99.2
3. Negative blood culture
4. JVD 3.5 cm

Infectious Diseases of the Heart

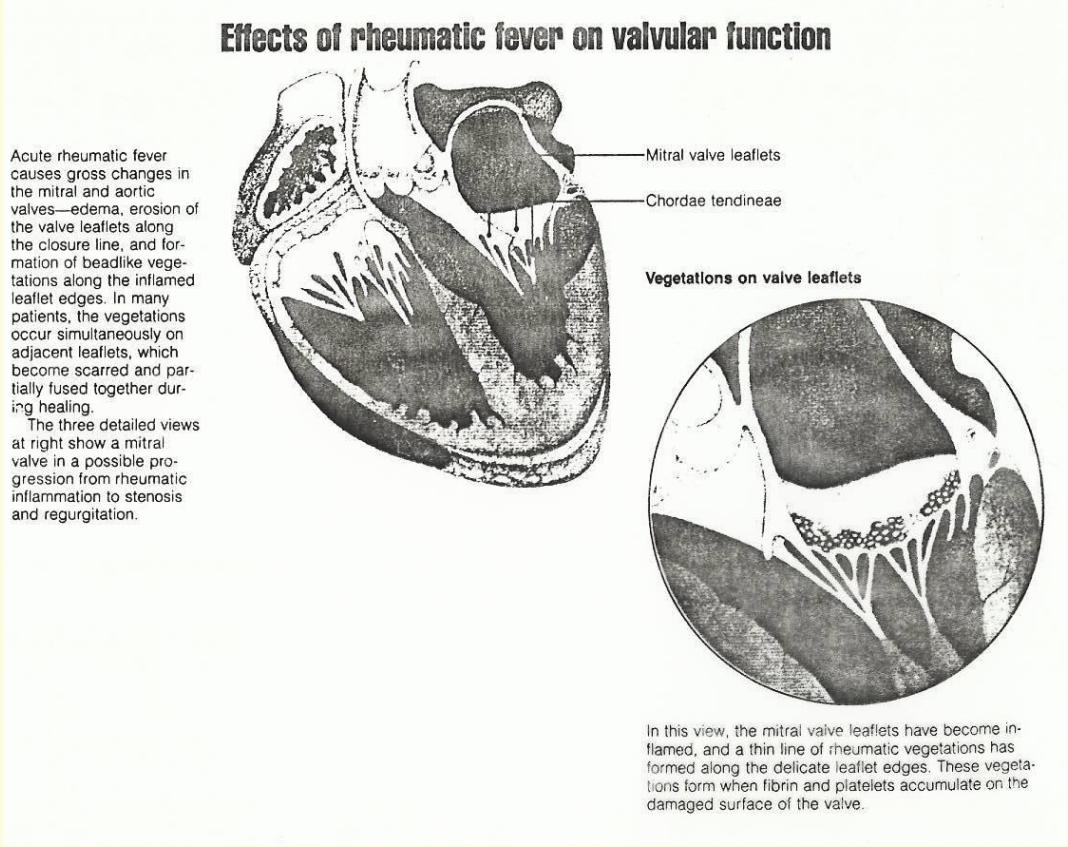
- Infective Endocarditis:
  - Complications:
    - Severe heart failure
    - Uncontrolled infection; septicemia
    - Embolic episodes
    - Conduction disturbances

Infectious Diseases of the Heart

- Rheumatic Endocarditis:
  - Specific type of infective endocarditis
    - Causative cootie:

    - Causes a systemic reaction
    - Causes damage to the valves with resultant leakage or obstruction

Infectious Diseases of the Heart



Infectious Diseases of the Heart

- Rheumatic Endocarditis:
  - Etiology:
    - Sudden onset of sore throat
    - Red throat
    - Exudate
    - Swollen, tender lymph nodes
    - Headache
    - Fever of 101 to 104 degrees F.

Infectious Diseases of the Heart

- Rheumatic Endocarditis:
  - Signs and symptoms:
    - Polyarthritis
    - Carditis
    - Chorea
    - Erythema marginatum
    - Subcutaneous nodules
    - Fever
    - Prolonged PR interval
    - Heart murmurs
    - Pleural or pericardial friction rubs

Infectious Diseases of the Heart

- Rheumatic Endocarditis:
  - Management:
    - Diagnosis:
      - Throat culture
      - Blood culture
      - WBC, sedimentation rate
      - History and physical exam

Infectious Diseases of the Heart

- Rheumatic Endocarditis:
  - Management:
    - Treatment:
      - Antibiotics
      - Rest
      - Salicylates

What is a preventative measure for rheumatic fever?

1. Early culture of sore throats
2. Close follow up of persons who have had the disease
3. Family hygiene measures and handwashing
4. Childhood immunization

Infectious Diseases of the Heart

- Myocarditis:
  - Definition:
    - Inflammation of the myocardial muscles

Infectious Diseases of the Heart

- Myocarditis:
  - Etiology:
    - Begins with an infectious process:
      - Viral
      - Bacterial
      - Mycotic
      - Parasitic
      - Protazoal
      - Rickettsial
      - Spirochetal

Infectious Diseases of the Heart

- Myocarditis:
  - Etiology:
    - Can occur after chemotherapy (Adriamycin)
    - Happens in patients with sarcoidosis, collagen diseases
    - Can occur in persons who are immunocompromised

Infectious Diseases of the Heart

- Myocarditis:
  - Signs and symptoms:
    - Can be minor and unnoticed
    - Vary, depending upon the type of infection, degree of damage, capacity to recover
    - Fatigue, dyspnea
    - Palpitations or precordial discomfort

Infectious Diseases of the Heart

- Myocarditis:
  - Signs and symptoms:
    - Cardiomegaly
    - Murmurs
    - S3
    - Heart failure
    - Dysrhythmias

Infectious Diseases of the Heart

- Myocarditis:
  - Management:
    - Treat the heart failure
    - Treat the dysrhythmias
    - Bedrest
    - Antimicrobial agents
    - Weigh daily

What is a preventative measure for myocarditis?

1. Annual flu shot
2. Avoid persons with the flu
3. Wear a protective mask
4. Stay home if afflicted with the flu
5. Anti-viral IV agents

Infectious Diseases of the Heart

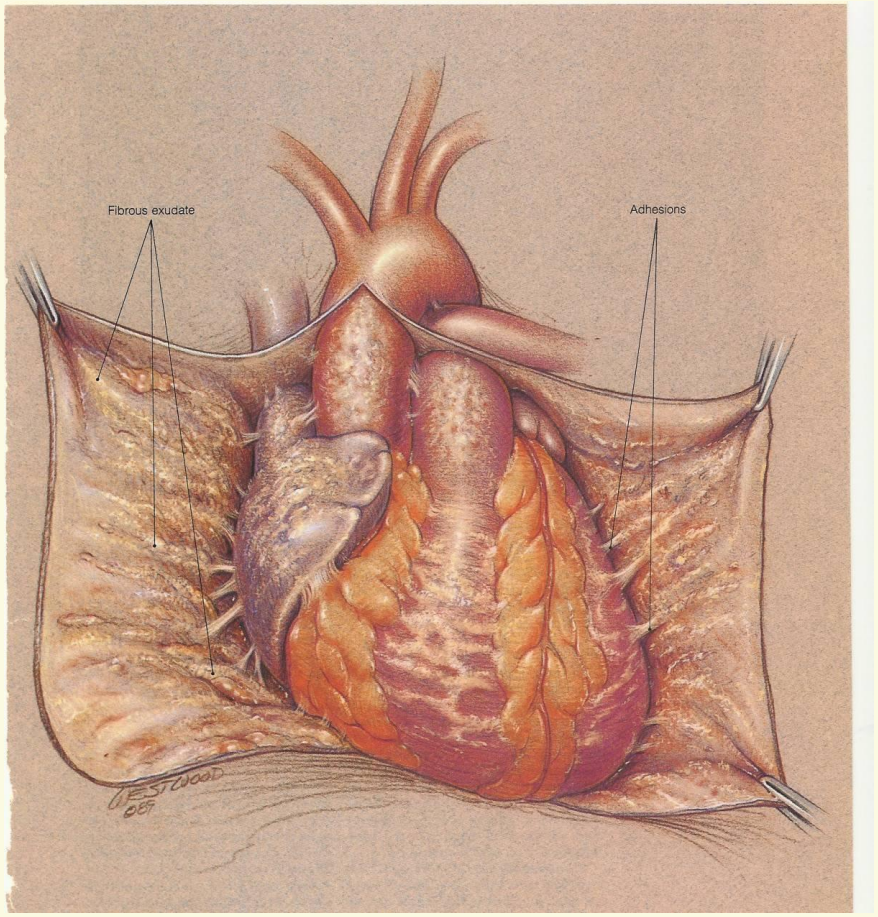
- Myocarditis:

  Can lead to permanent myocardial damage. Myocarditis is a trigger for the development of dilated cardiomyopathy. The only really effective treatment for this problem is heart transplant.

Infectious Diseases of the Heart

- Pericarditis:
  - Definition:
    - Inflammation of the pericardium. This is often a manifestation of a more generalized disease.

Infectious Diseases of the Heart



Infectious Diseases of the Heart

- Pericarditis:
  - Etiology:
    - Idiopathic
    - After infection
    - Connective tissue disorders
    - After AMI
    - After radiation therapy for cancer
    - After chest trauma or open heart surgery
    - Drug induced

Infectious Diseases of the Heart

- Pericarditis:
  - Signs and symptoms:
    - Anterior chest pain
      - Aggravated by motion
      - Toothache to sharp sensation
    - Pericardial friction rub
    - Dyspnea
    - Fever, sweating, chills
    - Dysrhythmias

Infectious Diseases of the Heart

- Pericarditis:
  - Management:
    - Diagnosis:
      - Echocardiogram
      - Chest X-ray
      - WBC
      - Serologic tests

Infectious Diseases of the Heart

- Pericarditis:
  - Management:
    - Treatment:
      - Antimicrobials
      - NSAIDS
      - Treat the cause

Infectious Diseases of the Heart

- Pericarditis:
  - Complications:
    - Pericardial effusion
    - Cardiac tamponade
    - Constrictive pericarditis

Infectious Diseases of the Heart

- Pericardial effusion:
  - Definition:
  - Signs and symptoms:
    - “Fullness” in the chest
    - Substernal pain
    - None if fluid accumulates gradually

Infectious Diseases of the Heart

- Cardiac tamponade:
  - Definition:
  - Signs and symptoms:
    - Falling arterial BP
    - Rising venous pressure
    - Distant, muffled heart sounds
    - Acute heart failure

Infectious Diseases of the Heart

- Cardiac tamponade:
  - Emergency treatment:
    - Pericardiocentesis

Infectious Diseases of the Heart

- Chronic constrictive pericarditis:
  - Definition:
    - Chronic inflammatory thickening of the pericardium due to long-standing infection. Usually occurs post viral infection or after tuberculosis.

Infectious Diseases of the Heart

- Chronic constrictive pericarditis:
  - Signs and symptoms:
    - Heart failure
    - Chronic atrial fibrillation

Infectious Diseases of the Heart

- Chronic constrictive pericarditis:
  - Management:
    - Diagnosis:
      - Echocardiogram
      - Chest X-ray

Infectious Diseases of the Heart

- Chronic constrictive pericarditis:
  - Management:
    - Treatment:
      - Pericardial window
      - Pericardiectomy

Cardiomyopathies

Definition:

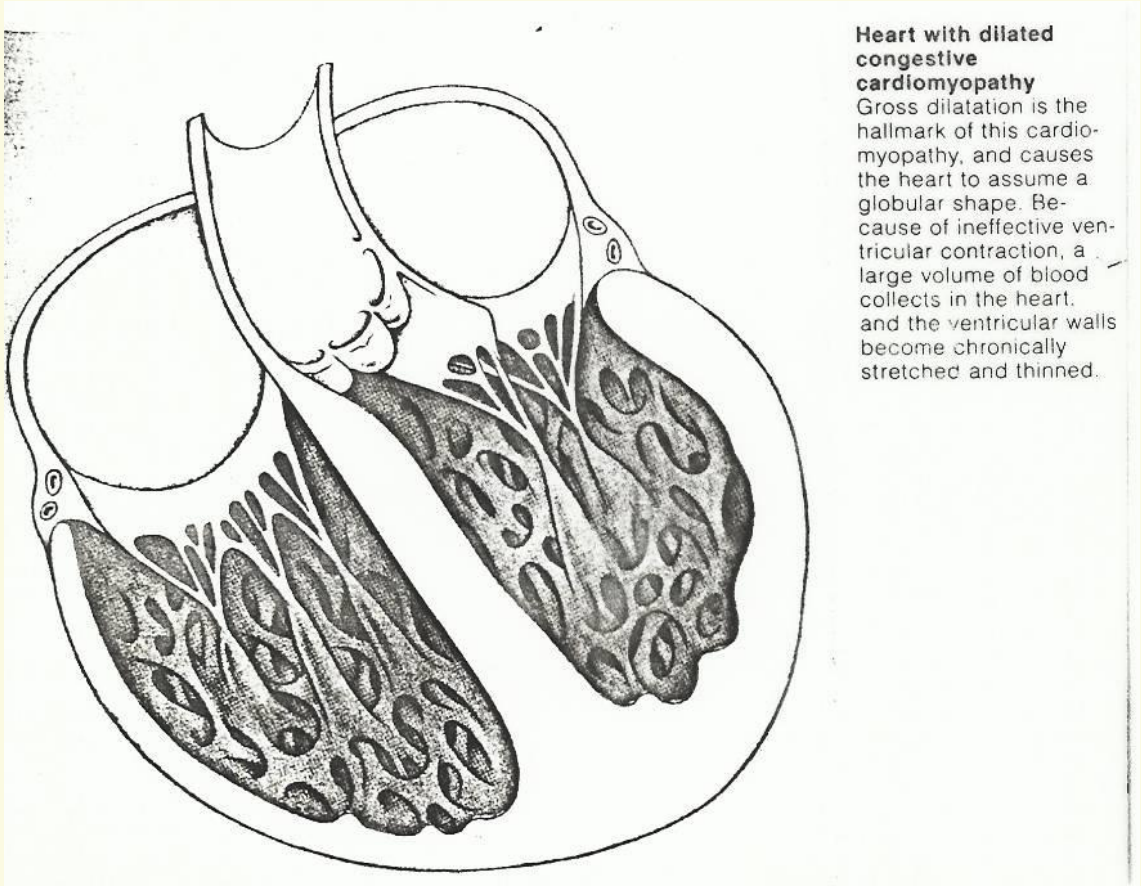
Cardiomyopathies

- Types of cardiomyopathies:
  - Dilated
  - Hypertrophied
  - Restrictive
  - Ischemic
  - Takotsubo's

Cardiomyopathies

- Etiology:
  - Dilated:
    - Alcohol abuse
    - Chemotherapy induced
    - Chemical agents
    - Pregnancy
    - After infections (flu)

Cardiomyopathies

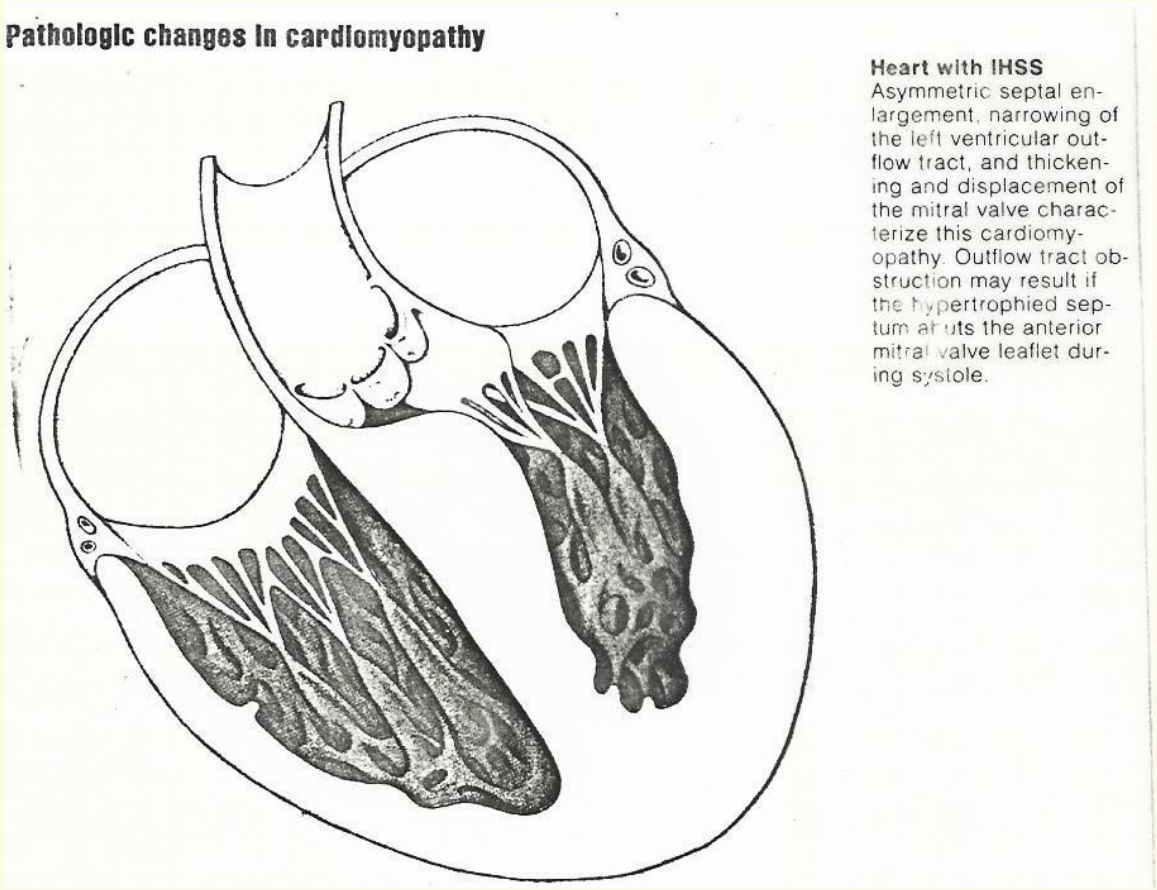


Heart with dilated congestive cardiomyopathy
Gross dilatation is the hallmark of this cardiomyopathy, and causes the heart to assume a globular shape. Because of ineffective ventricular contraction, a large volume of blood collects in the heart, and the ventricular walls become chronically stretched and thinned.

Cardiomyopathies

- Etiology:
  - Hypertrophied:
    - Genetic transmission

Cardiomyopathies



Cardiomyopathies

- Etiology:
  - Restrictive:
    - Occurs after amyloid and hemochromatosis (excessive iron depositions)
  - Ischemic:
    - Due to fibrotic changes that occur with long term, diffuse ischemia to the myocardial muscle

Cardiomyopathies

- Takotsubo cardiomyopathy:
  - AKA: Broken heart syndrome
  - AKA: Stress induced cardiomyopathy
  - It is reversible.
  - It can be lethal
  - Must be managed symptomatically until recovery

Cardiomyopathies

- Signs and symptoms:
  - Depend upon the type of cardiomyopathy
    - Dyspnea
    - Chest pain
    - Dysrhythmias
    - Heart failure
    - Syncope

Valve Diseases

- Function, normal heart valves

Valve Diseases

- Types of valve damage:
  - Stenosis:
  - Insufficiency:

Valve Diseases

- Valves affected in order of frequency:
  - Mitral
  - Aortic
  - Tricuspid
  - Pulmonic

Valve Diseases

- Reasons for acquired valve damage:
  - Infective endocarditis – usually rheumatic endocarditis
  - Vegetation may create permanent scarring or malformation of one or more valve leaflets
  - More than one valve may be affected

Valve Diseases

- Compensatory changes of valve disease:
  - Distal chamber hypertrophies
  - Arrhythmias
  - Decreased forward blood flow

What hemodynamic findings should the nurse expect with valve diseases?

1. Elevated pulmonary artery pressure
2. Low CVP
3. High PAWP
4. Low systemic vascular resistance

Valve Diseases

- Mitral valve prolapse:

Definition:

Valve Diseases

- Mitral valve prolapse:
  - Signs and symptoms:
    - Chest pain
    - Dizziness
    - Palpitations
    - Systolic click

Valve Diseases

- Mitral valve prolapse:
  - Signs and symptoms:
    - Dysautonomias
      - Panic attacks
      - Diarrhea/constipation
      - PMS (from hell)
      - Joint symptoms
      - Headaches
      - Sleep disorders
      - Fatigue

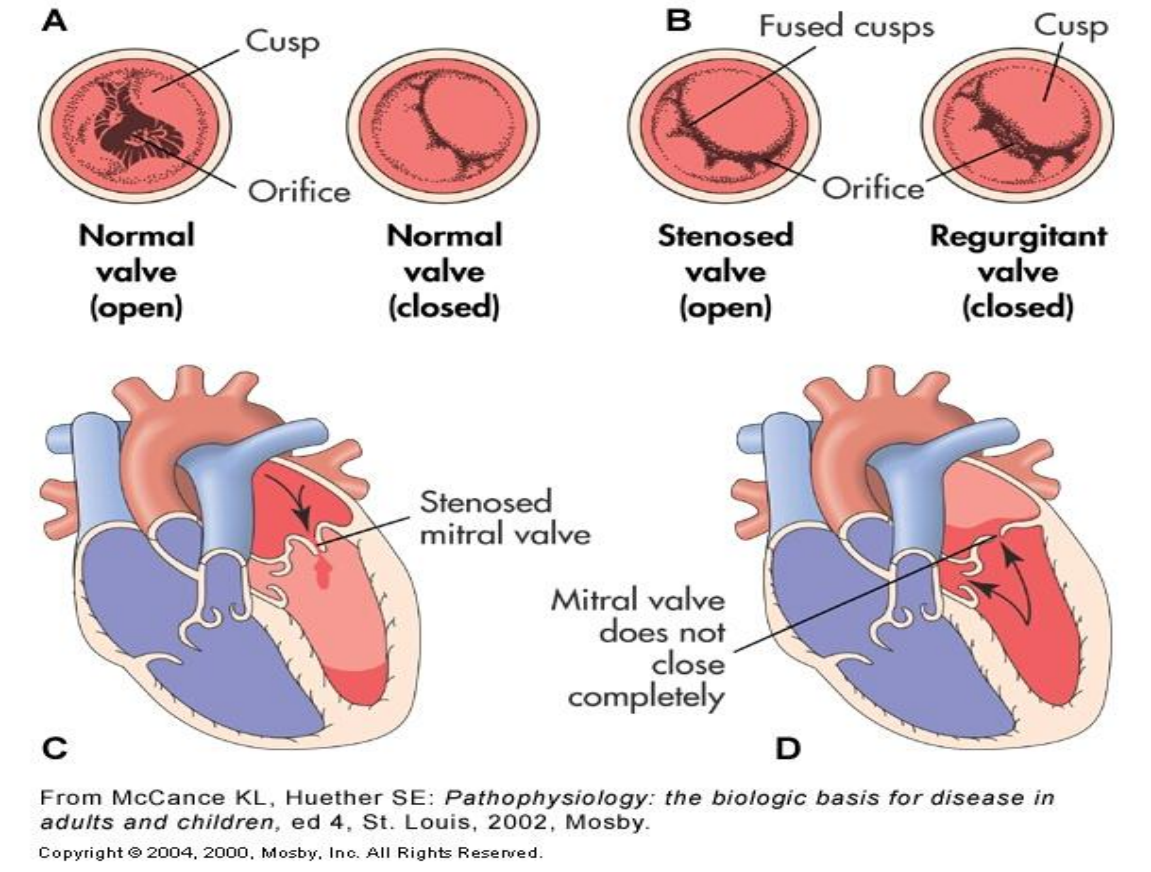
Valve Diseases

- Mitral valve prolapse:
  - Treatment:
    - Beta blockers
    - Calcium channel blockers
    - Decrease caffeine
    - Decrease alcohol
    - Decrease tobacco
    - Decrease sugar
    - Increase fluids
    - Sensible exercise
    - Prophylactic antibiotics

Valve Diseases

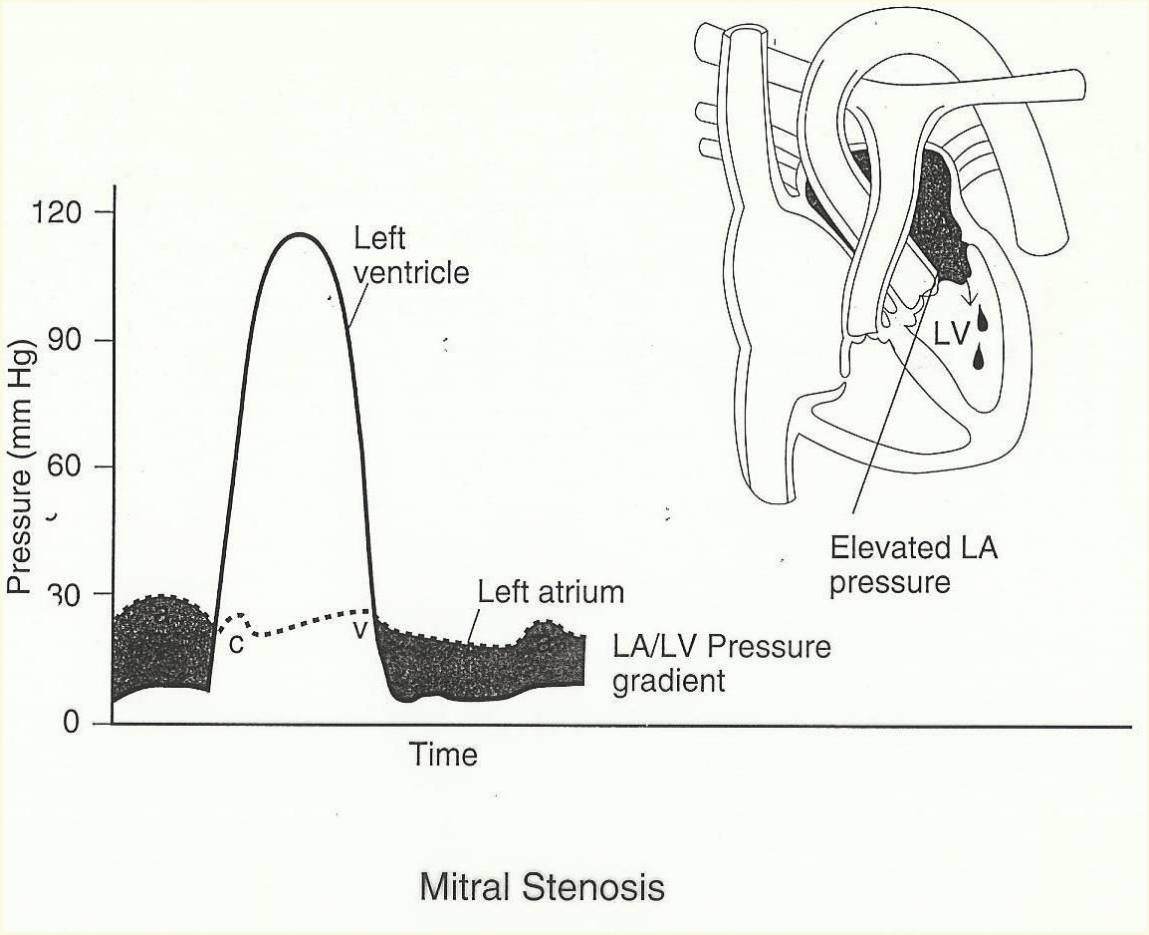
- Mitral Stenosis:
  - Etiology
  - Signs and symptoms

Valve Diseases



From McCance KL, Huether SE: *Pathophysiology: the biologic basis for disease in adults and children,* ed 4, St. Louis, 2002, Mosby.

Valve Diseases



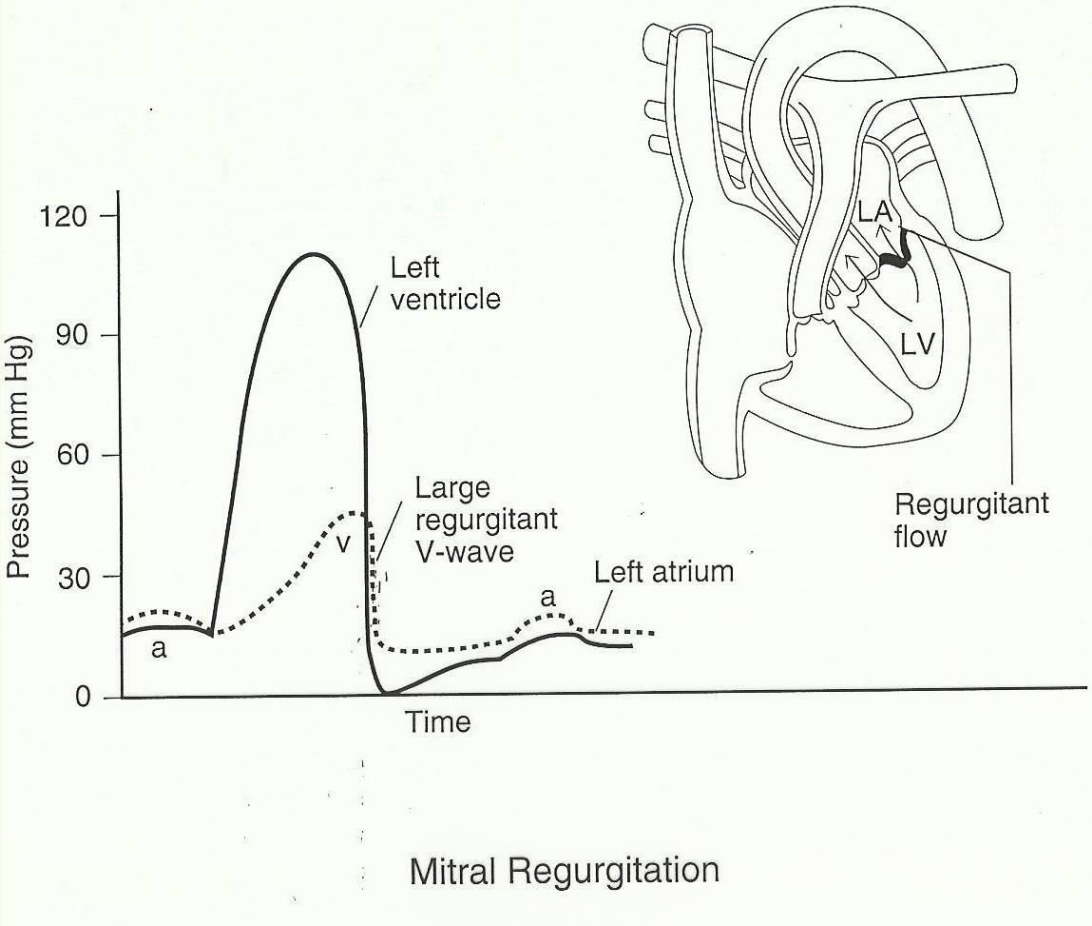
Valve Diseases

- Mitral Stenosis:
  - Management:
    - Diagnosis
    - Treatment

Valve Diseases

- Mitral insufficiency:
  - Etiology
  - Signs and symptoms

Valve Diseases



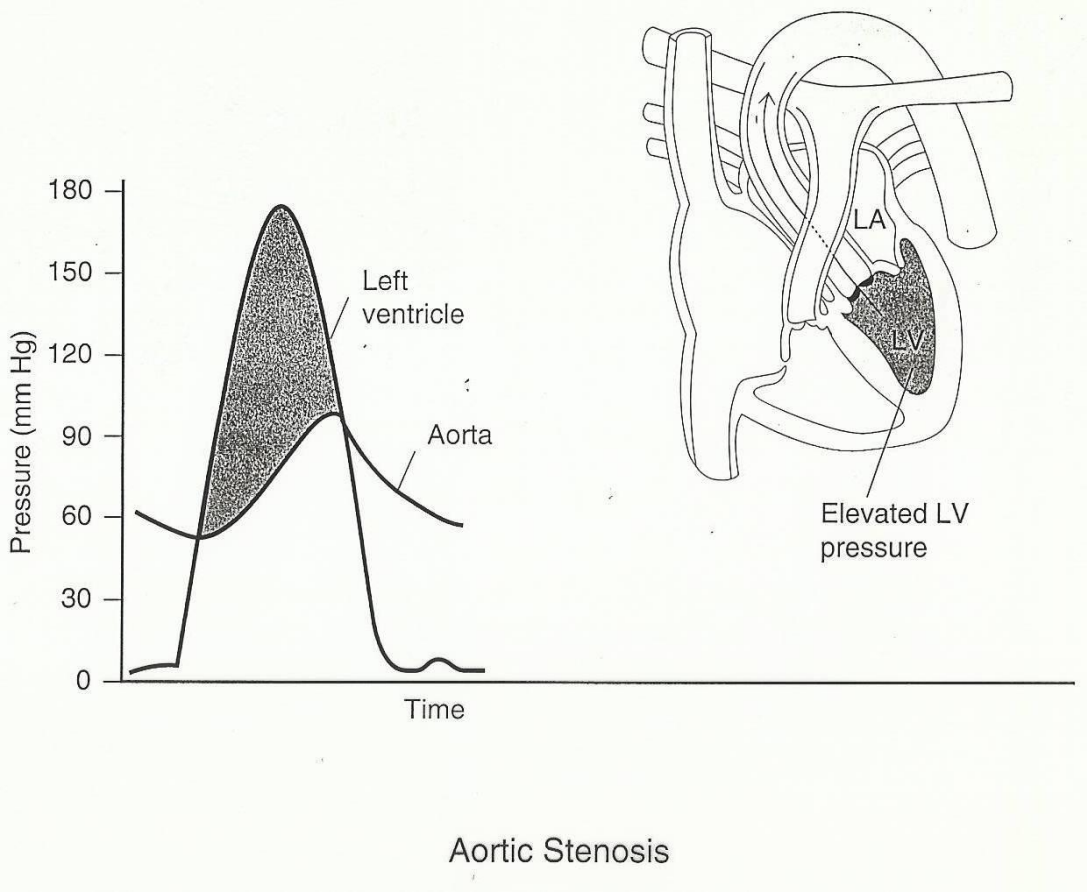
Valve Diseases

- Mitral insufficiency:
  - Management:
    - Diagnosis
    - Treatment

Valve Diseases

- Aortic stenosis:
  - Etiology
  - Signs and symptoms

Valve Diseases



Valve Diseases

- Aortic stenosis:
  - Diagnosis
  - Treatment

Valve Diseases

- Aortic Insufficiency:
  - Etiology:

Valve Diseases

- Aortic Insufficiency:
  - Signs and symptoms:

Valve Diseases

- Aortic Insufficiency:
  - Diagnosis:
  - Treatment:

Valve Diseases

- Tricuspid lesions:
  - Stenosis: after rheumatic fever, frequently occurs with mitral valve disease
  - Insufficiency: most common cause is dilation of the right ventricle

Valve Diseases

- Tricuspid lesions:
  - Signs and symptoms:
    - Stenosis
    - Insufficiency

Valve Diseases

- Tricuspid lesions:
  - Management:
    - Stenosis:
      - Diagnosed by ECG, heart catherization, echocardiogram, and chest X-ray
      - Treated by diuretics, sodium restriction, surgical intervention

Valve Diseases

- Tricuspid lesions:
  - Management:
    - Insufficiency:
      - Diagnosed by CXR, ECG, echocardiogram
      - Treated by valvuloplasty, valve replacement

Valve Diseases

- Surgical treatment:
  - Commissurotomy:
    - Usually performed on the mitral valve, rarely on the tricuspid.
      - Closed: Small chest incision-atrium opened-surgeon uses finger or dilator to release a stenotic valve-does not directly visualize the valve-does not require CPB
      - Open: Long incision-direct visualization-uses CPB-fused valves are carefully dissected

Valve Diseases

- Balloon valvuloplasty:
  - Used on stenotic tricuspid or mitral valves
  - Does not require thoracotomy or CPB
  - Catheter threaded into the right heart
  - Balloon inflated at tricuspid valve to open it
  - Catheter guided through atrial septum
  - Balloon inflated in mitral valve to open it

Valve Diseases

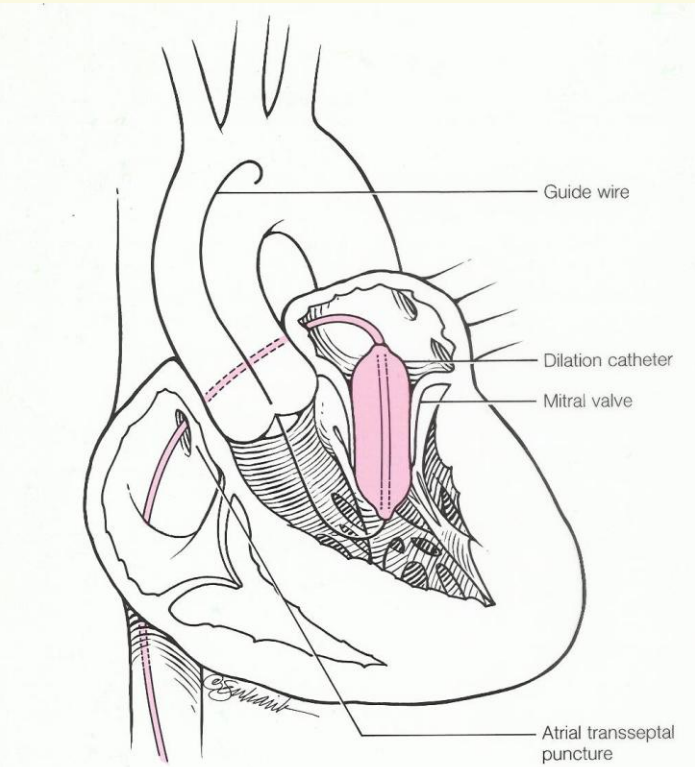
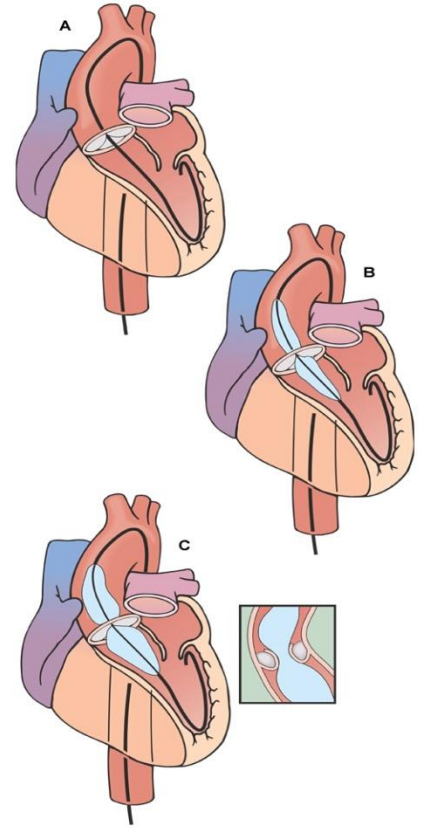


FIGURE 30–7. Balloon valvuloplasty.

Valve Diseases



Redrawn from Block PC: Balloon valvuloplasty, *Cardiol Consult* 9:4, 1988.

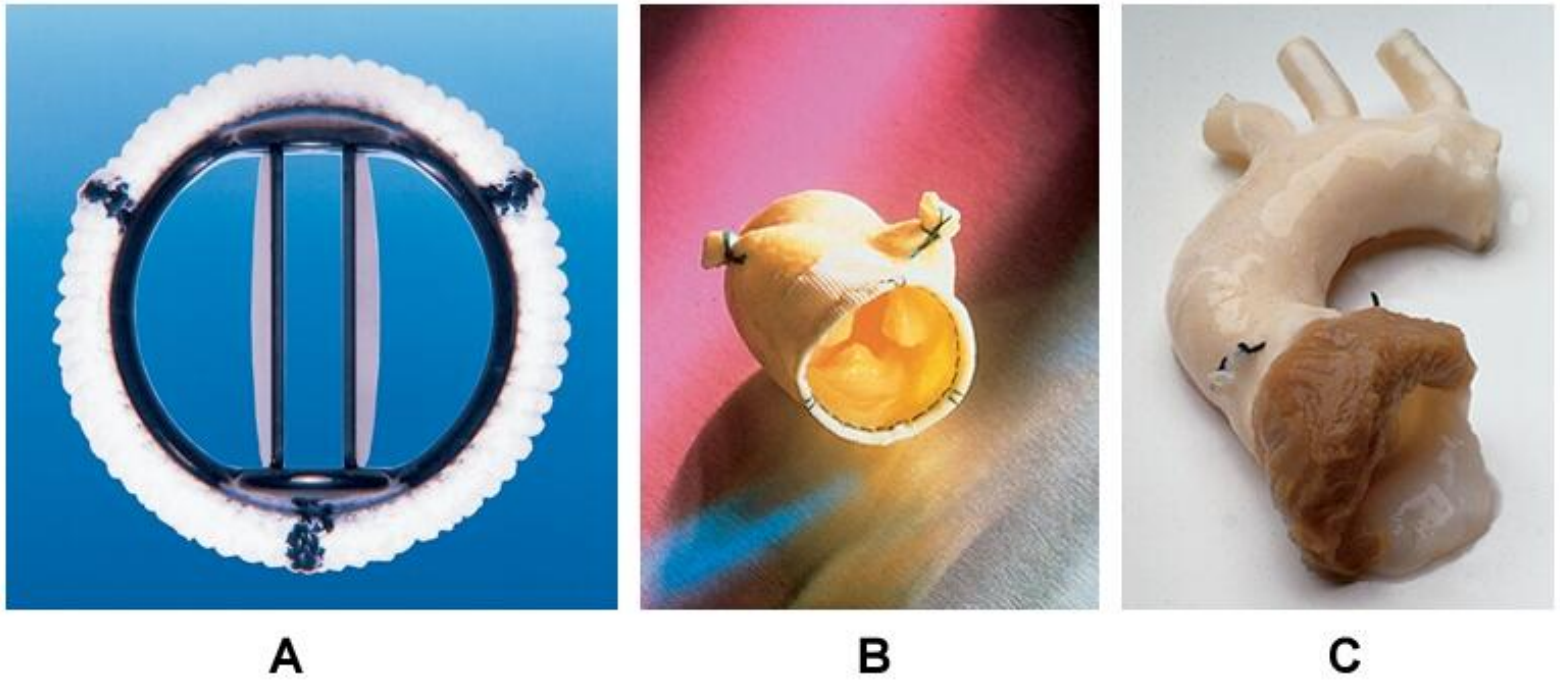
Valve Diseases

- Types of valve repairs:
  - Valvuloplasty
  - Annuloplasty
  - Valve replacement

Valve Diseases

- Types of valve replacements:
  - Autograft
  - Homograft
  - Xenograft
  - Artificial or mechanical

Valve Diseases



A B C

A, Courtesy St. Jude Medical, Inc., St. Paul, MN. B, Courtesy Medtronic, Inc., Irvine, CA. C, Courtesy American Red Cross Tissue Services and Baxter Healthcare Corporation. CardioVascular Group, Santa Ana, Calif.

Valve Diseases

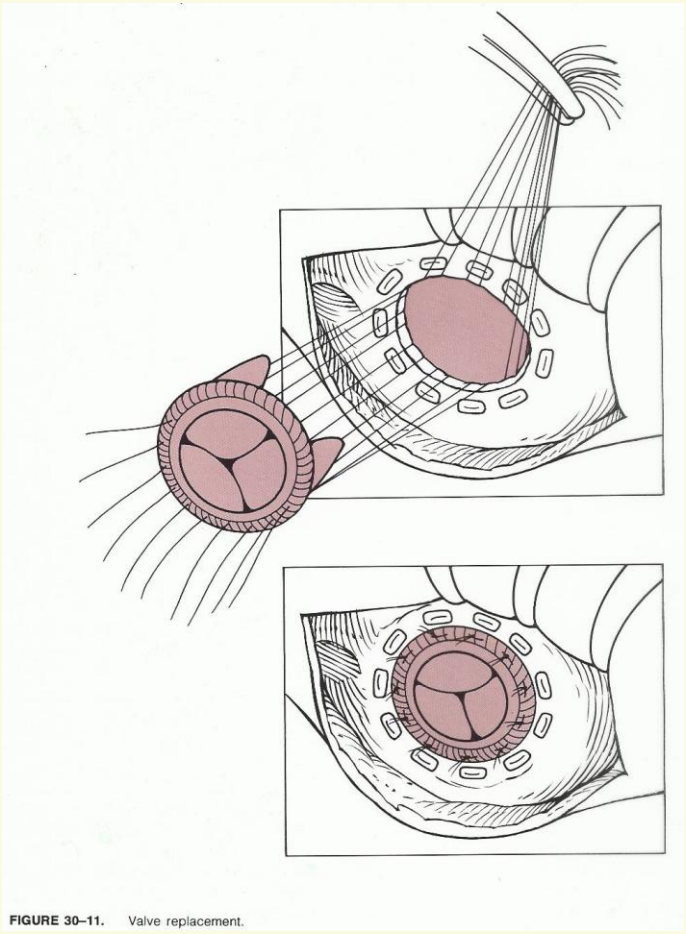


FIGURE 30–11. Valve replacement.

So what type of valve surgery would you prefer?

1. Total artificial valve
2. Xenograft valve
3. Autograft valve
4. Balloon valvuloplasty
5. Open valvuloplasty

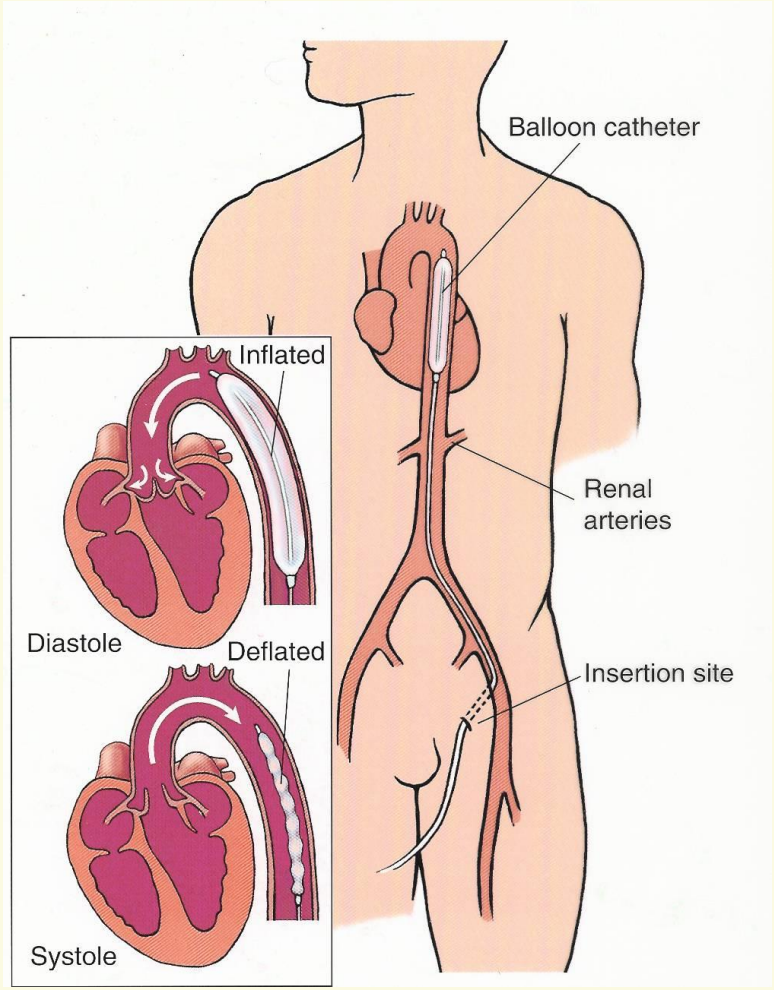
Intra-Aortic Balloon Pump

- Definition of IABP:
  - A machine and catheter combination that performs “counterpulsation” in the aorta to reduce afterload and decrease MVO2. It also increases O2 supply to the myocardium

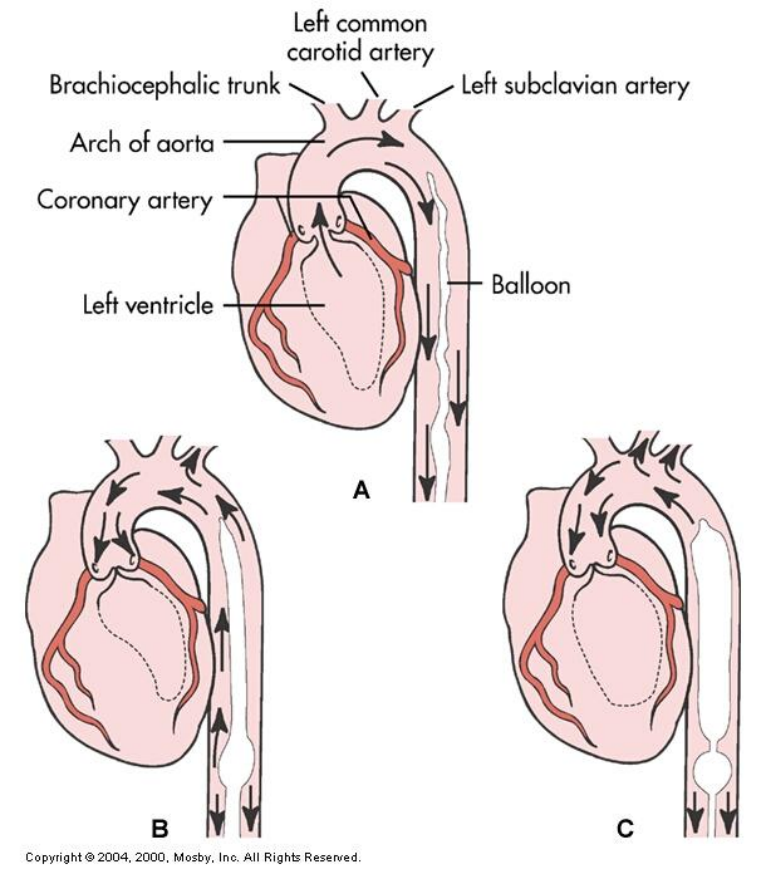
Intra-Aortic Balloon Pump

- Definition of counterpulsation:
  - The balloon catheter inflates during diastole and deflates during systole. Balloon inflation causes blood to perfuse the systemic vascular bed with more force. It also pushes blood back towards the closed aortic valve to perfuse the coronary arteries with extra blood.

Intra-Aortic Balloon Pump



Intra-Aortic Balloon Pump



Intra-Aortic Balloon Pump

- **Indications for IABP**:
  - Management of cardiogenic shock after AMI.
  - Wean patients from cardiopulmonary bypass.
  - Treat unstable angina until primary coronary intervention can be performed.
  - Limit infarct size during acute MI.
  - Treat heart failure due to ventricular aneurysm or papillary muscle rupture until surgical repair.

Intra-Aortic Balloon Pump

- **Nursing responsibilities**:
- **Pre-procedure**:
  - Operative permit
  - Prep both groins
  - Assess peripheral pulses
  - Prophylactic antibiotic
  - Correct size catheter

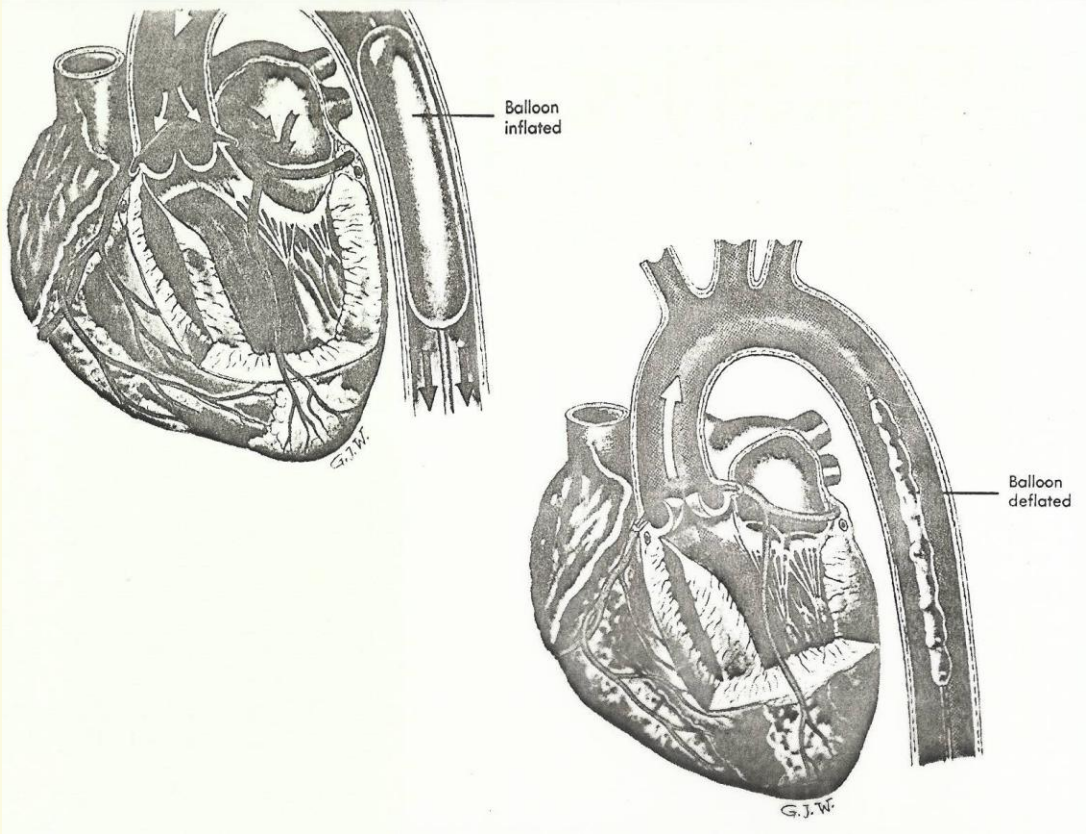
Intra-Aortic Balloon Pump

- **Post-procedure**:
  - Timing the console to the aortic waveform; use the dichrotic notch.
  - Monitor the patient closely for embolic complications.
  - Monitor platelet counts-the balloon crushes and destroys platelets.
  - Limit patient activity and mobility. Patients are on bedrest with no bending of the leg that has the catheter in it.
  - Continuously monitor peripheral pulses; patients who require this device frequently have peripheral vascular disease.

Intra-Aortic Balloon Pump

- **Complications**:
- Balloon problems:
  - Underinflation-does not assist the patient optimally.
  - Overinflation-causes damage to platelets and may traumatize the aorta.
  - Balloon may leak.
  - Balloon may break-helium gas is used to prevent air emboli.

Intra-Aortic Balloon Pump



Intra-Aortic Balloon Pump

- Console problems:
  - Balloon may inflate too soon-very bad if the balloon is inflated during systole-this can kill the patient.
  - Balloon may inflate too late-this does not provide as much help to the failing heart-the balloon should inflate as soon as possible during diastole and remain inflated as long as possible to assist the left ventricle and perfuse the coronary arteries.

Intra-Aortic Balloon Pump

- Position problems:
  - Balloon catheter can migrate upwards and block the arteries at the aortic arch, including the carotid.
  - Catheter can migrate downwards and block renal arteries.

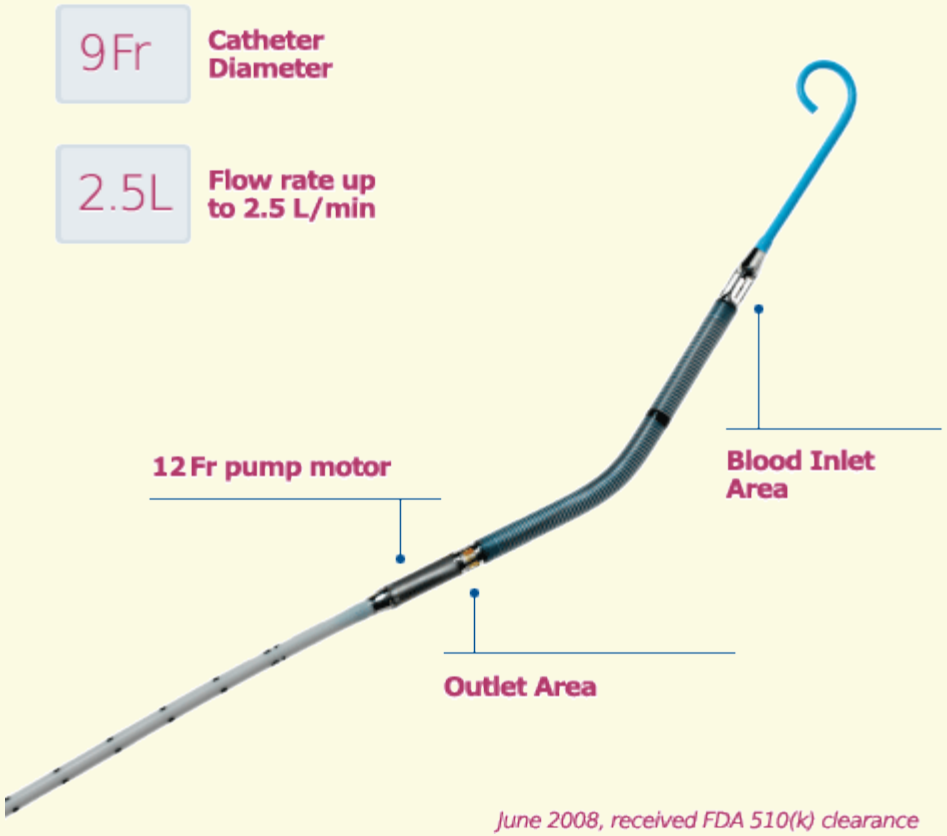
Intra-Aortic Balloon Pump

- More complications:
  - Aortic dissection
  - Infection with sepsis
  - Emboli

Intra-Aortic Balloon Pump

- **Weaning**:
  - Typically takes from 12 hours to two days to accomplish.
  - Initial weaning step is to augment every other heartbeat, then every third beat and finally every fourth beat.
  - The patient is closely monitored during the weaning process for heart failure and/or angina.

Impella 2.5



June 2008, received FDA 510(k) clearance

Heart Transplants and VAD's

- Indications for heart transplant:
  - End stage heart disease
  - Life expectancy < 1 year
  - Age 65 (68) or less
  - Minimal co-morbidities

Heart Transplants and VAD's

- Pre-operative assessments:
  - Complete health history and physical
  - Pulmonary function studies
  - Psychological evaluation
  - HLA matching
  - Usual labs, diagnostics for major surgery

Heart Transplants and VAD's

- Nursing interventions, pre-operative:
  - Supportive care
  - May be on VAD's or numerous vaso-active medications
  - Transplant coordinator is a nurse

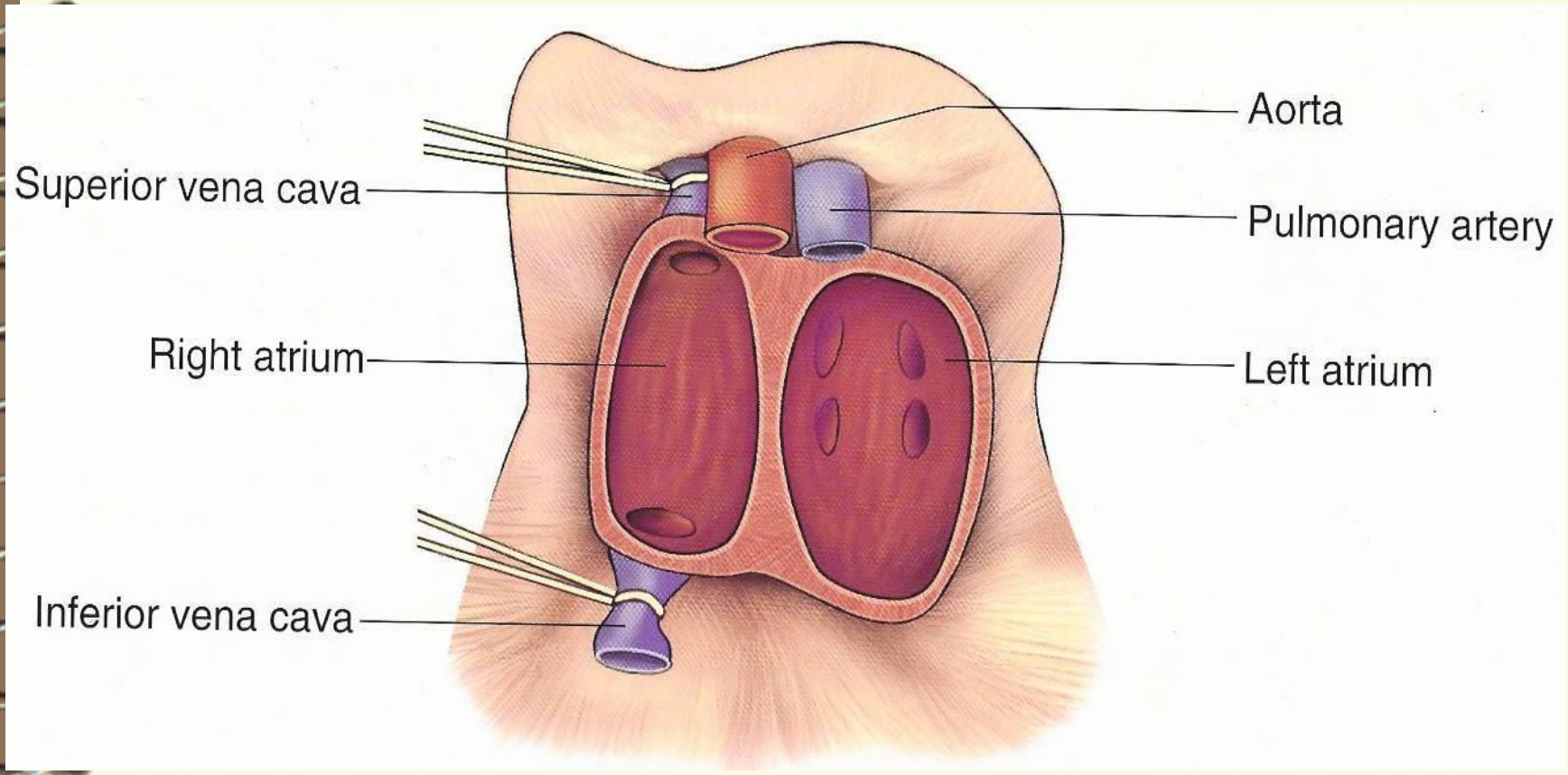
Heart Transplants and VAD's

- Nursing care, peri-operative:
  - Same care as any open heart surgery
  - CPB is necessary
  - Cardioplegia not needed
  - Hypothermia not needed

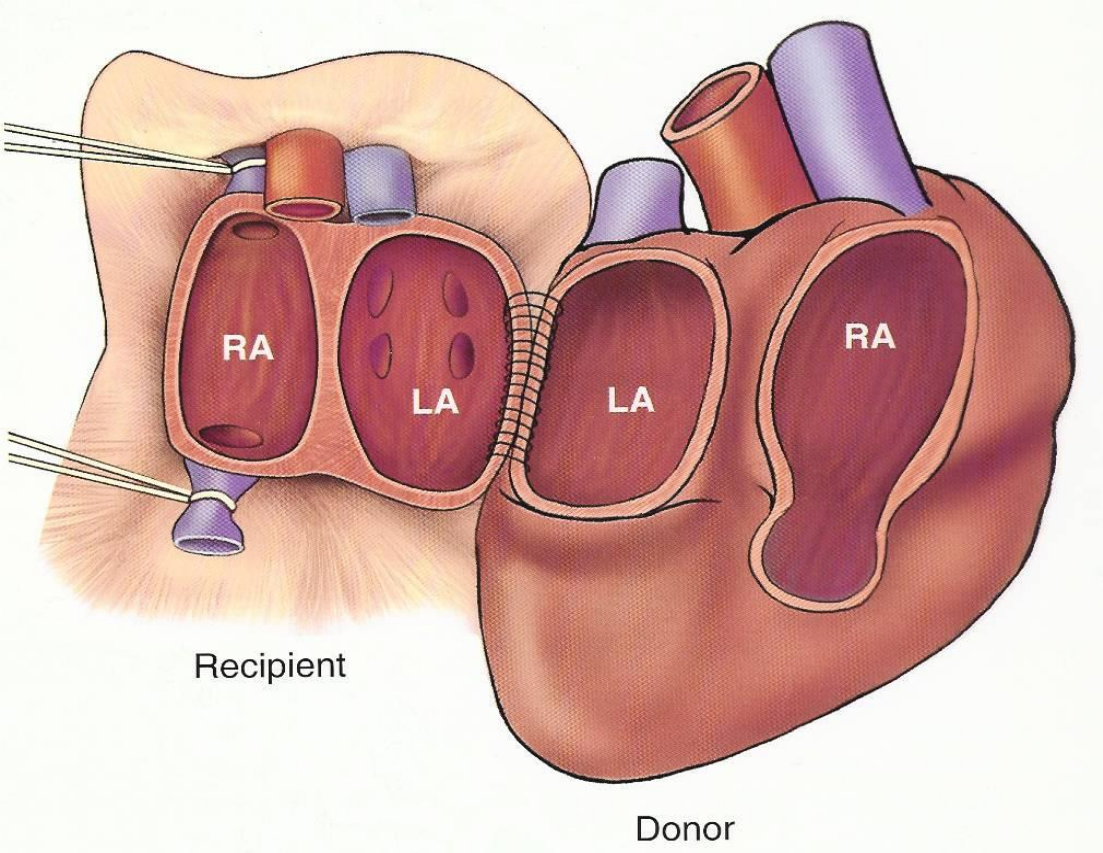
Heart Transplants and VAD's

- Surgical procedure:
  - Orthotopic method: Atrial flaps of old heart remain; new heart is sewn at the tops of the atria.
  - Heterotopic method: new heart implanted side by side with old heart-older method, no longer done.

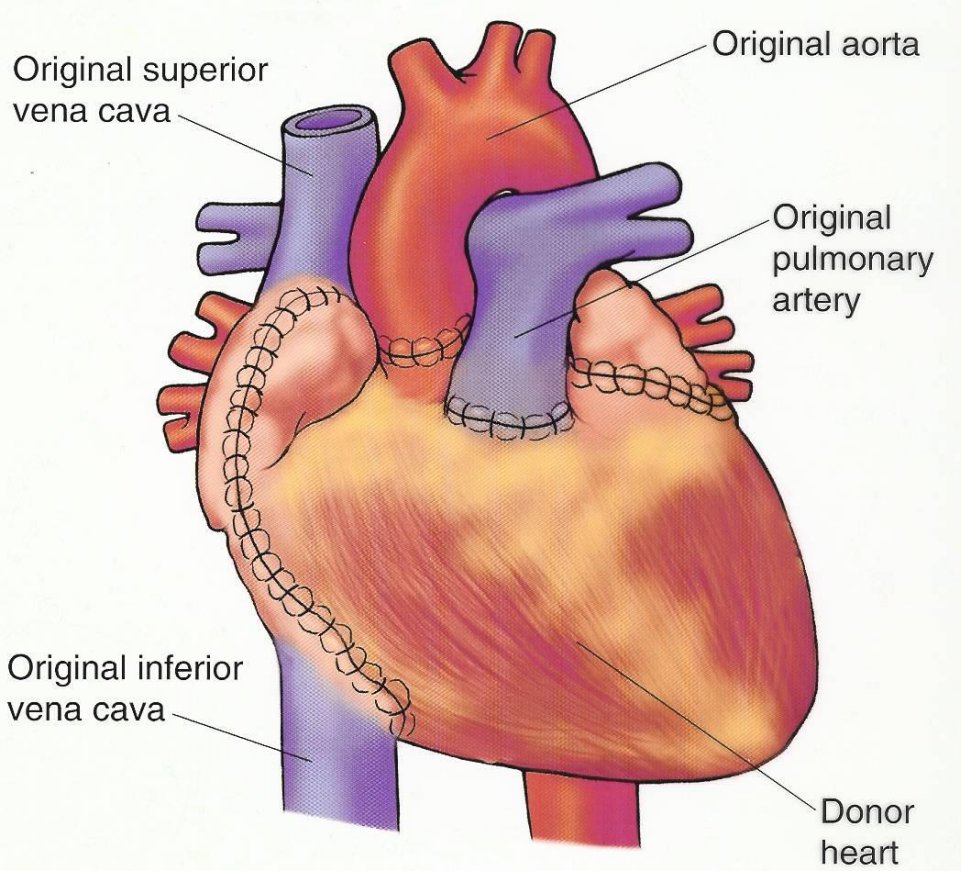
Heart Transplants and VAD's



Heart Transplants and VAD's



Heart Transplants and VAD's



Heart Transplants and VAD's

- Perform your own transplant on a person who needs a new heart. Go to:
- www.pbs.org/wbgh/nova/eheart/transplantwave.html

Heart Transplants and VAD's

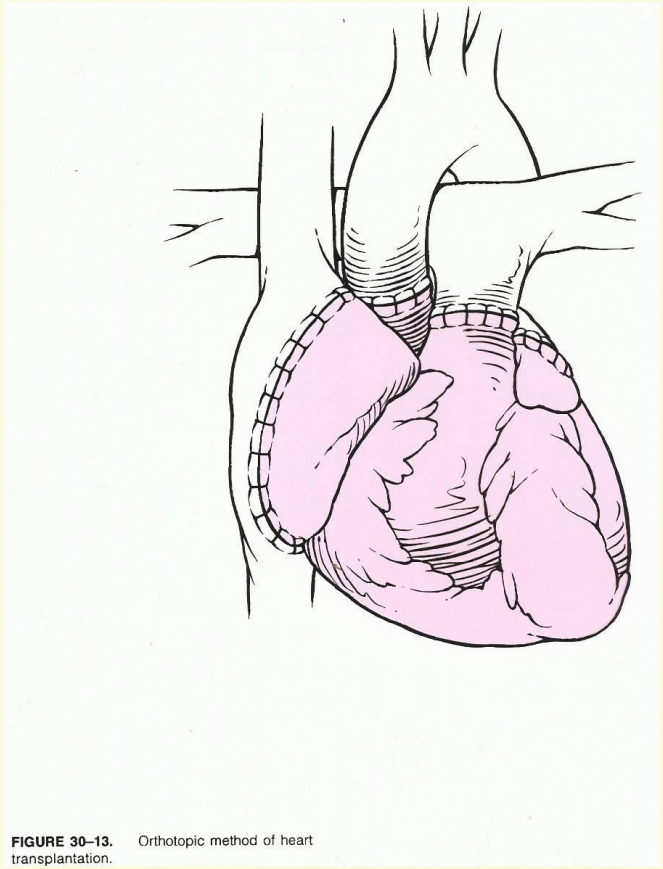


FIGURE 30–13. Orthotopic method of heart transplantation.

Heart Transplants and VAD's

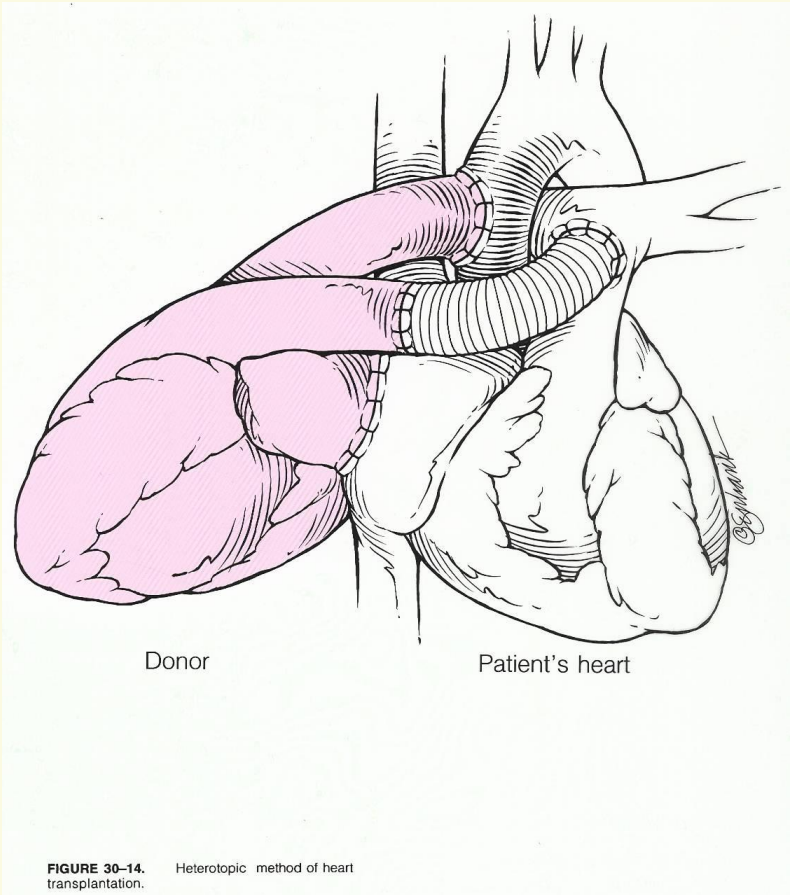


FIGURE 30–14. Heterotopic method of heart transplantation.

Heart Transplants and VAD's

- Nursing measures, post-operative:
  - Usual measures for any open heart patient
  - Infection control-on immunosuppressants
  - Pacemakers may be required
  - Two sinus P waves may be identified
  - No chest pain with ischemia

Heart Transplants and VAD's

- Patient Education:
  - Endomyocardial biopsies: Frequently at first then every three months
  - Immunosuppressive therapy
    - Cyclosporine
    - Prednisone
    - Prograf
    - Simulect
    - Zanapax

Heart Transplants and VAD's

- Patient Education:
  - Pacemaker therapy
  - Exercise prescription
  - Avoid infection

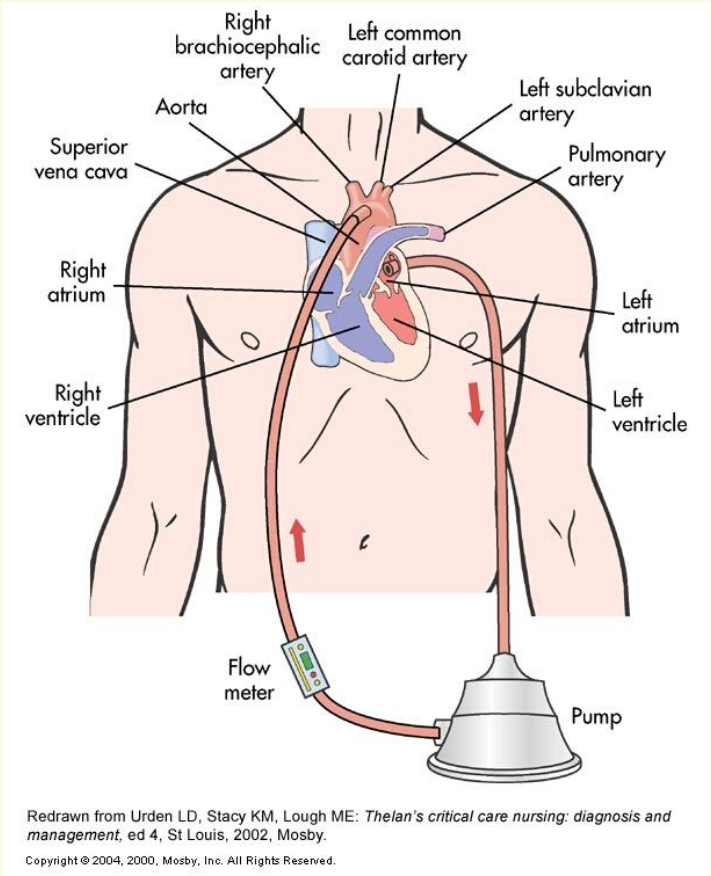
Heart Transplants and VAD's

- Ventricular Assist Devices:
  - Mechanical devices that support failing hearts and maintain circulation in periods of ventricular fibrillation or asystole.

Heart Transplants and VAD's

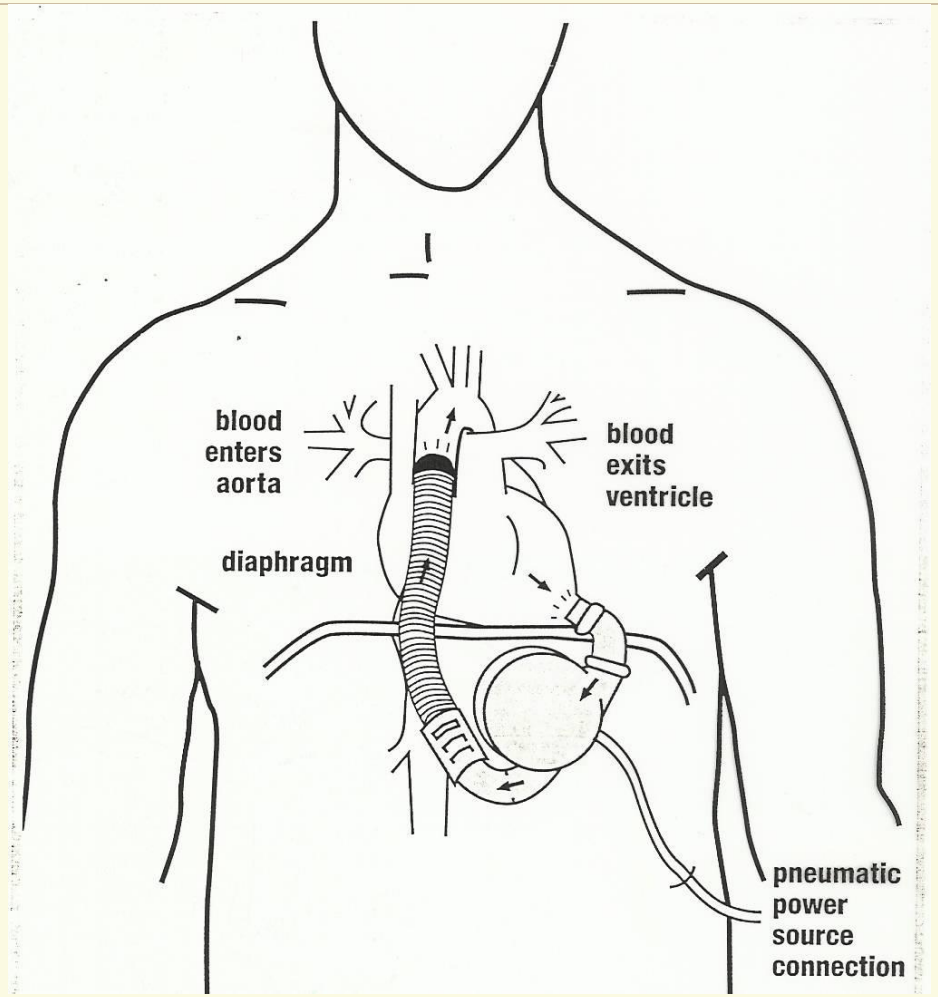
- Ventricular Assist Devices:
  - Types:
    - RVAD
    - LVAD
    - Bi VAD
    - Pneumatic, external
    - Rotating, internal

Heart Transplants and VAD's



Redrawn from Urden LD, Stacy KM, Lough ME: *Thelan's critical care nursing: diagnosis and management,* ed 4, St Louis, 2002, Mosby.

Heart Transplants and VAD's



Heart Transplants and VAD's

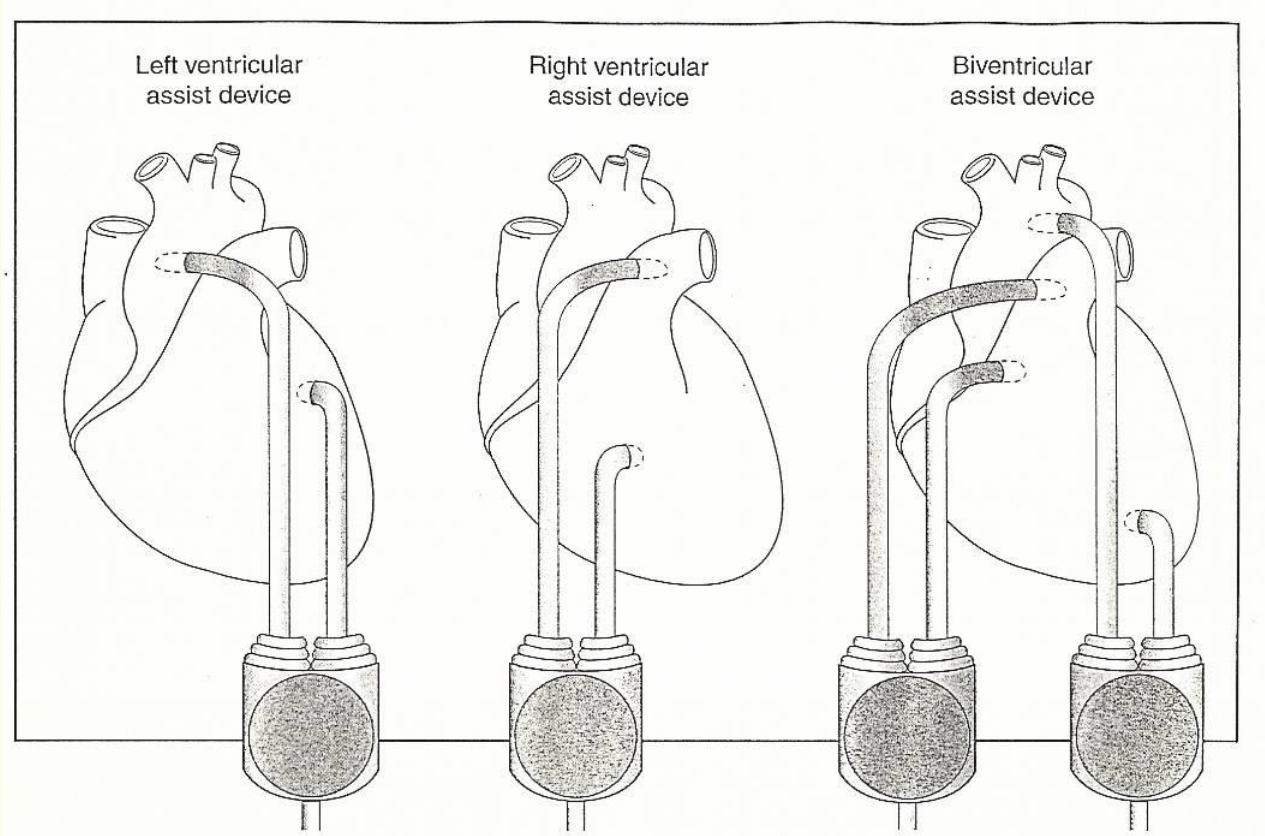


FIGURE 20–7. Types of ventricular assist devices. (Adapted from Quaal, SJ: VADs: Beyond intra-aortic balloon pumping. CV Nurse: Trends in Cardiovascular Care 5:5, and Vaska, PL: Biventricular assist devices. Crit Care Nurs 11:54.)

Heart Transplants and VAD's

- Ventricular Assist Devices:
  - Nursing considerations:
    - Work with perfusionist
    - Continuous hemodynamic assessment
    - Neurological assessment
    - Pain relief
    - Monitor for infection
    - Watch out for kinks in the tubing

Heart Transplants and VAD's

- Ventricular Assist Devices:
  - Psycho-social needs:
    - Need to live near hospital
    - Feel fine, but not living a "normal" life
    - Support groups
    - Waiting for someone to die
    - Makes noise

What nursing diagnosis would be a priority for a VAD client?

1. Decreased cardiac output
2. Risk for infection
3. Risk for fluid volume excess
4. Impaired cardiopulmonary tissue perfusion
5. Knowledge deficit

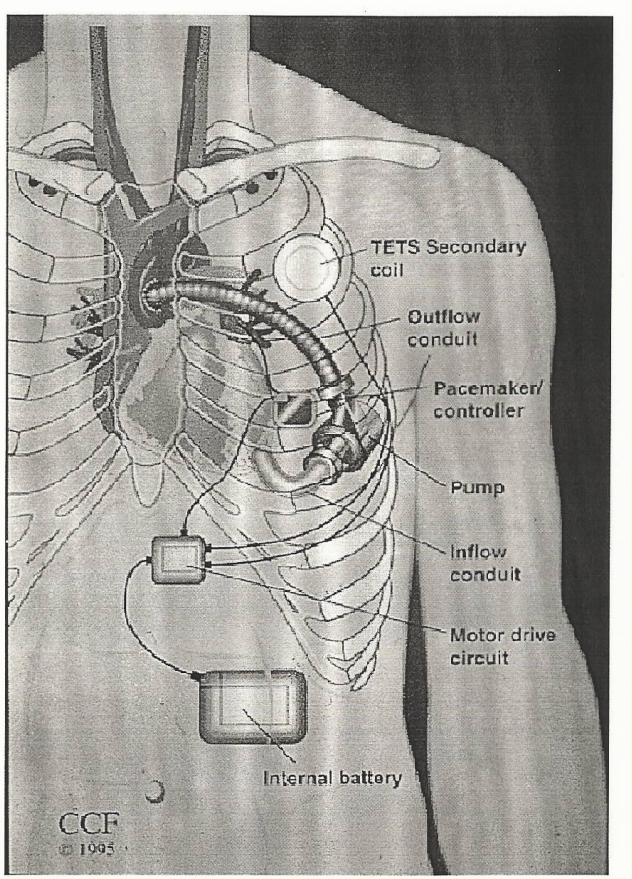
Heart Transplants and VAD's

- Total artificial heart:

  Totally mechanical device; no endothelium; patients died of embolic strokes

  Technology needed

Heart Transplants and VAD's



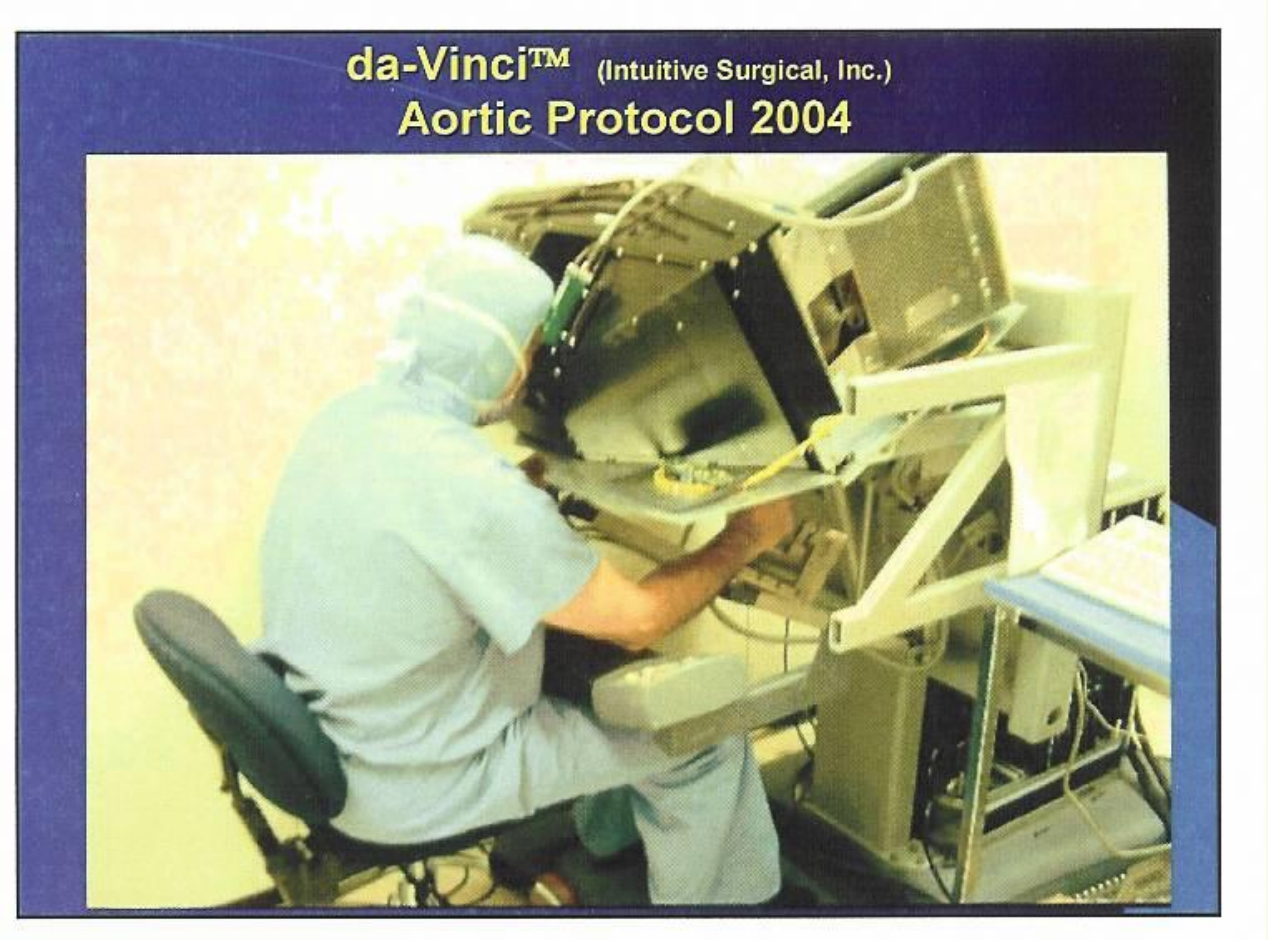
What's New

- Robotic repairs of hearts and blood vessels.
  - Operating surgeon is at a computer in the corner of the OR
  - Robotic arms and instruments perform the surgery
  - A surgeon is also at the patient's side to assist.

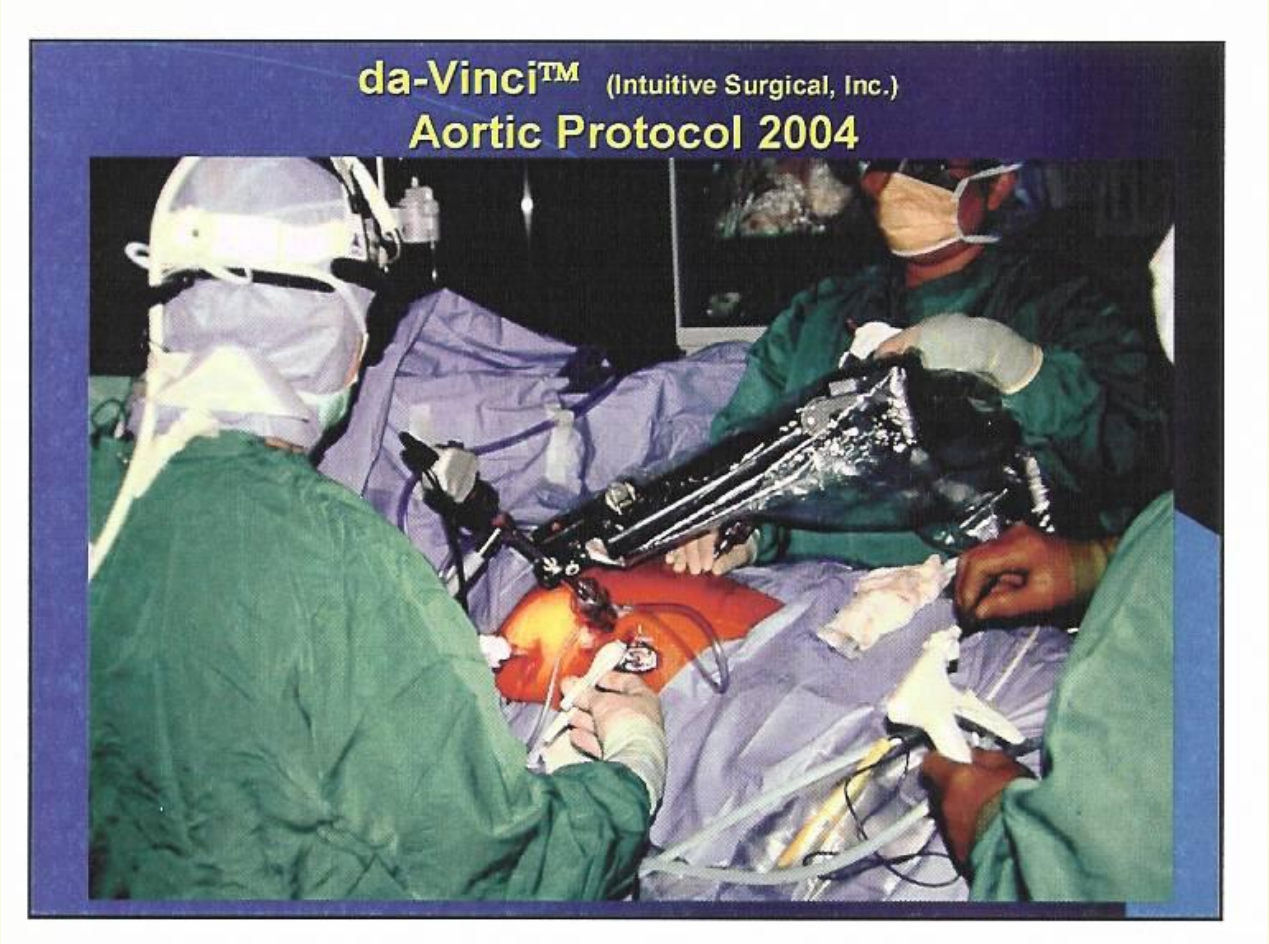
What's New


da-Vinci™ (Intuitive Surgical, Inc.)
Aortic Protocol 2004
TRAINING
CONSOLE
STAND-BY SURGEON
da-VINCI SYSTEM

What's New



What's New



What's New

- Percutaneous Aortic Valve Replacement
  - No heart surgery required
  - Custom made replacement valve is inserted through femoral artery
  - Old valve is opened and new valve put in place
  - Quick recovery

What's New

- Percutaneous aortic valve replacement:
  - Corrects aortic stenosis
  - Excellent for older, frail persons
  - Improves quality of life
  - Must have two good femoral arteries
  - Use balloon valve stent system
  - Pace HR at >200 to reduce CO for placement

What's New

- Aortic valve stenting:

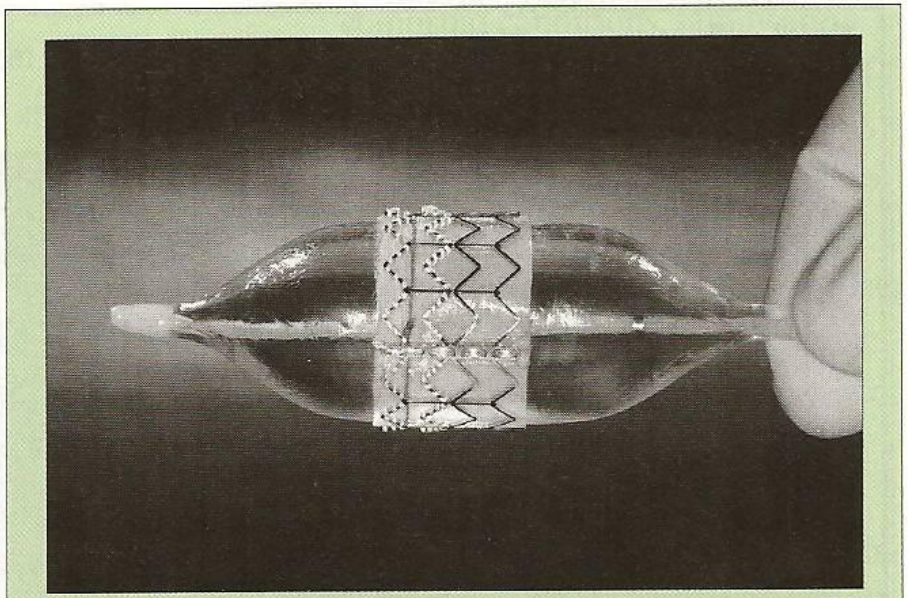


Figure 3 Stent over valvuloplasty balloon.

Photograph provided by J. Webb, MD, St. Paul's Hospital, Vancouver, British Columbia.

What's New

- Aortic Valve stenting:

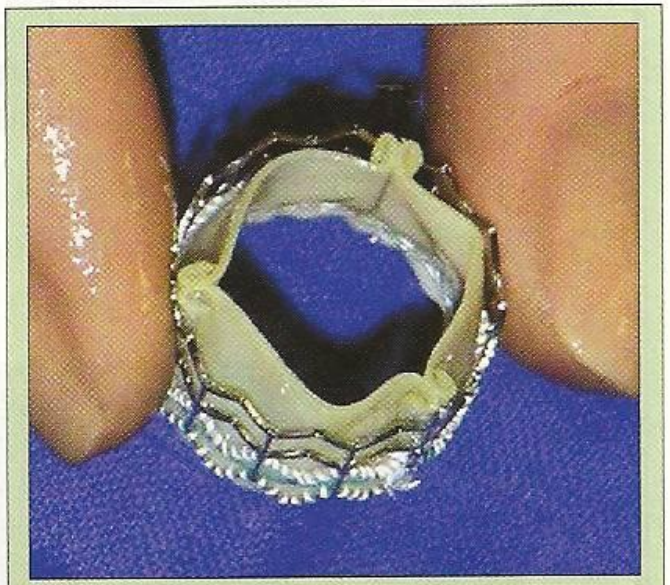


Figure 4 Stent valve.

Photograph provided by J. Webb, MD, St. Paul's Hospital, Vancouver, British Columbia.

What's New

- Aortic Valve stenting:

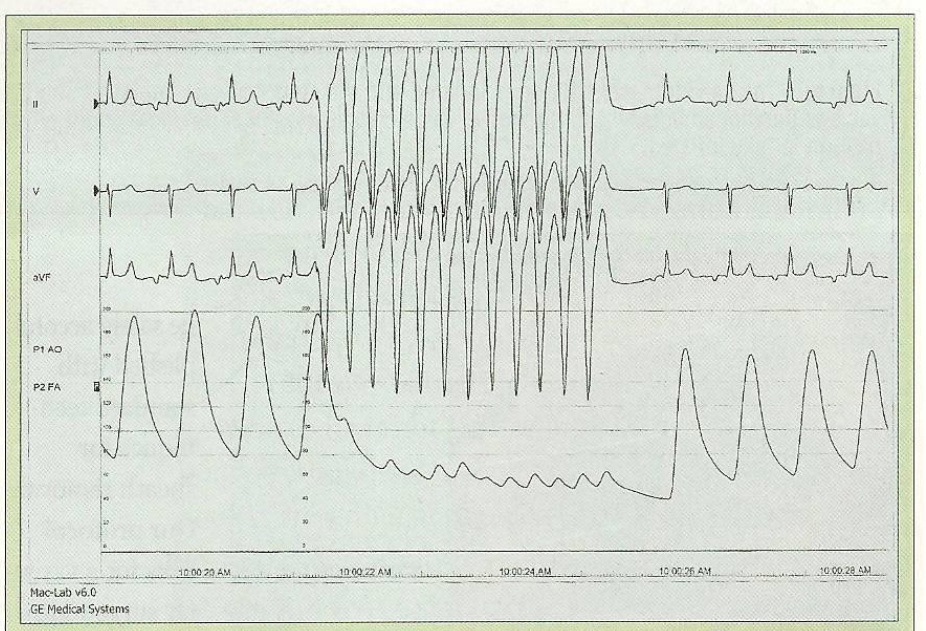


Figure 5 Rapid ventricular pacing during valve-stent deployment. Electrocardiogram and arterial waveform tracing show rapid ventricular pacing with associated decreased arterial blood pressure.

Reprinted with permission from the cardiac catheterization laboratory, St. Paul's Hospital, Vancouver, British Columbia.

What's New

- Aortic valve stenting:

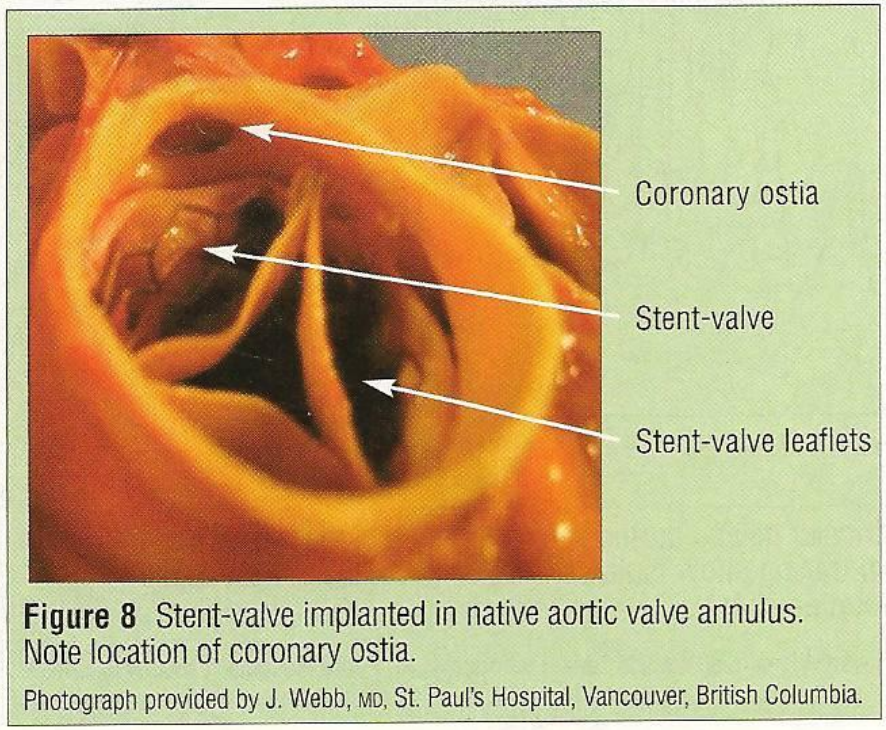


Figure 8 Stent-valve implanted in native aortic valve annulus. Note location of coronary ostia.

Photograph provided by J. Webb, MD, St. Paul's Hospital, Vancouver, British Columbia.