

*Module A*

*Cardiovascular Alterations*

*NUR 203*

## Hemodynamic Monitoring

Is an invasive system used in critical care areas to provide quantitative information about vascular capacity, blood volume, pump effectiveness, and tissue perfusion.

- Directly measures pressures in the heart and great vessels
- Requires informed consent
- Preparation of a pressure-monitoring system
  - Pulmonary artery catheter
  - Infusion system and transducer
  - Monitor
- Phlebostatic Axis
  - Position the patient supine
  - Palpate the 4<sup>th</sup> intercostal space at the sternum
  - Follow the 4<sup>th</sup> intercostal space to the side of the patient's chest
  - Determine the midway point between anterior and posterior
  - Find the intersection between the midway point and the line from the 4<sup>th</sup> intercostal space, and mark it with a X in the indelible ink. This is the phlebostatic axis.

## Pulmonary Artery Catheter

- Multi-lumened catheter inserted through a large vein (IJ or Subclavian) and is then directed toward the right atrium
- When the catheter tip reaches the RA the physician inflates the balloon, the catheter advances with the flow of blood in a branch of the pulmonary artery, the balloon is deflated when it reaches the pulmonary artery
- The catheter receives pressure waves and the transducer converts this mechanical energy into electrical energy which is displayed as waveforms or numbers on the monitor
- Measurement of pressures:
  - Right atrial pressure: RA
  - Pulmonary artery pressure: PAP
  - Pulmonary artery wedge pressure: PAWP or PAOP (LA and LVEDP)
  - Central venous pressure: CVP
  - Cardiac Output: CO

## Pressures

Right Atrial Pressure	Pulmonary Artery Pressure	Pulmonary Artery Wedge Pressure (PAWP) or Pulmonary Artery Occlusive Pressure (PAOP)	Central Venous Pressure
<p><b>Normal:</b> 1 to 8 mm Hg</p> <p><b>Increased:</b> right ventricular failure</p> <p><b>Decreased:</b> hypovolemia</p>	<p>15 to 26 mm of Hg systolic/5 to 15 mm Hg diastolic (mean of 15)</p> <p>Constantly seen on the monitor</p> <p><b>Increased:</b> hypertension, pulmonary edema</p> <p><b>Decreased:</b> dehydration, diuretics</p>	<p>Balloon inflated, becomes wedged in branch of pulmonary artery</p> <p>The tip of wedged catheter senses pressures from left atrium which reflect left ventricular end-diastolic pressure</p> <p><b>Normal:</b> 4-12 mm Hg</p> <p><b>Increased:</b> left ventricular failure, hypervolemia, mitral regurgitation, cardiac shunt</p> <p><b>Decreased:</b> hypovolemia, afterload reduction</p>	<p>Pressure within the superior vena cava</p> <p>Reflects the pressure under which blood is returned to the heart</p> <p><b>Normal:</b> 5-10cm H2O</p> <p><b>Increased:</b> overload (heart failure)</p> <p><b>Decreased:</b> reduce blood volume</p>

## Cardiac Output

- May be obtained continuously or intermittent
- **Normal:** 4 to 6L/min
- **Increased:** sepsis
- **Decreased:** abnormal heart rate, decreased contractility, decreased preload, increased afterload

## Cardiac Index

- Determined by dividing the CO by the body surface area (BSA)
- **Normal range** is 2.7-3.2 L/min/m<sup>2</sup>

## Complications of Pulmonary Artery Catheters

Dysrhythmias, Infection, Thrombophlebitis, Air embolism, Pneumothorax, Myocardial perforation, Valvular damage

## Mixed Venous Oxygen Saturation Monitoring SvO<sub>2</sub>

- Balance between the client's oxygen supply and demand
- Measurements between 60%-80% represent adequate tissue delivery and utilization
- **Increased:** higher supply of oxygen than demand
- **Decreased:** low supply of oxygen and increase need for oxygen  
*(maybe your client just needs suctioned)*

## **Arterial Lines**

- Direct measurement of arterial BP by the use of an invasive arterial catheter
- Special training
- Usually 10 to 15mm Hg greater than indirect measurements
- Complications: pain, infection, obstruction at the site, air embolism, hemorrhage

## **Impedance Cardiography**

- Noninvasive
- 4 ICG electrodes, 4 ECG electrodes and a portable ICG monitor to measure impedance to the flow of electricity in the heart
- Can be used in any setting
- Used for client with heart failure, trauma, or needing fluid management
- Measures thoracic fluid, LV function, preload, afterload, and contractility

## Interventions for Clients w/Dysrhythmias

### Terms to Review

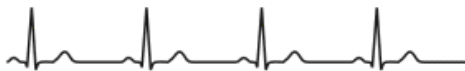
- **Automaticity** – (*pacings function*) is the ability of cardiac cells to generate an electrical impulse spontaneously and repetitively.
- **Excitability** – the ability of non-pacemaker heart cells to respond to an electrical impulse that begins in pacemaker cells and to depolarize.
- **Conductivity** – ability to send an electrical stimulus from cell membrane to cell membrane.
- **Contractility** – ability of atrial and ventricular muscle cells to shorten their fiber length in response to electrical stimulation, causing sufficient pressure to push blood forward through the heart.  
(*mechanical activity of heart*)
- **SA node** – where conduction begins, located close to the surface of the right atrium near its junction with the superior vena cava. *Heart's primary pacemaker.*
- **AV junctional area** – consists of a transitional cell zone, the AV node itself, and the bundle of His. Just beneath the right atrial endocardium, between tricuspid valve and ostium of coronary sinus.
- **Bundle branch system** – bundle of His extends as a right bundle branch down the right side of the interventricular septum to the apex of the right ventricle. On the left side, it extends as a left bundle branch, which further divides. Bundle of His connects w/the distal portion of the AV node.
- **Purkinje fibers** – interweaving network located on the endocardial surface of both ventricles, from apex to base. Partially penetrate into the myocardium.



## Electrocardiography

- Provides a view of the electrical system of the heart
- Multiple views or leads can be seen
- Isoelectric line—baseline—no electrical activity occurring
- Positive, negative, and biphasic deflections
  
- 12 Lead ECG
- **P wave** – atrial depolarization.
- **PR segment** – isoelectric line from the end of the P wave to the beginning of the QRS complex.
- **PR interval** – measured from the beginning of the P wave to the end of the PR segment. Time required for atrial depolarization as well as the impulse delay in AV node and travel time to Purkinje fibers.
- **QRS complex** –ventricular depolarization.
- **QRS duration** – the time required for depolarization of both ventricles. Measured from beginning of the QRS complex to J point (where QRS ends and the ST segment begins).
- **ST segment** – normally an isoelectric line and represents early ventricular repolarization. From J point to beginning of T wave.

## Atrioventricular Blocks



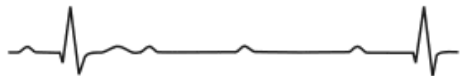
Normal



First-Degree AV Block

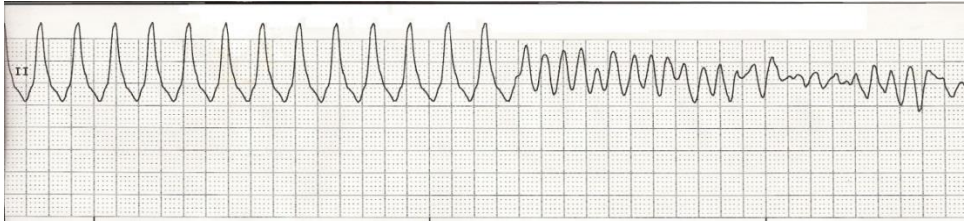


Second-Degree AV Block (2:1)



Third-Degree AV Block

## V-Tach followed by Ventricular Fibrillation



## Pacing



## Cardioversion

- Synchronized countershock
- Used to treat tachydysrhythmias
- Hold Digoxin for 48 hours preceding if an elective cardioversion
- Elective cardioversions of A-Fib or Flutter need anticoagulation for 4 to 6 weeks prior to cardioversion; TEE before Cardioversion; Can cardiovert VT w/pulse
- Monitor with defibrillator in synchronized mode; intended to stop the re-entry circuit and allow the sinus node to regain control of the heart
- **Chemical** – ABC (*Adenosine/Atropine, Beta-Blockers, Calcium Channel Blockers*)
- **LAP** – Lidocaine, Amiodarone, Procainamide

## Post-Cardioversion Care

- Maintain airway
- Administer oxygen
- Assess vital signs and level of consciousness
- Administer antidysrhythmics
- Monitor for dysrhythmias
- Assess for chest burns
- Emotional support
- Document: energy level, at what level did the client convert, how tolerated procedure, VS, LOC, and current rhythm

## **Defibrillation**

- Asynchronous countershock, depolarizes a critical mass of myocardium simultaneously to stop the re-entry circuit, allowing the sinus node to regain control of the heart
- Early defibrillation is critical in terminating pulseless VT or VF
- AED

## **Radiofrequency Catheter Ablation**

- Invasive procedure
- Used to destroy an irritable focus or foci that is causing SVT or VT
- EP studies must be completed prior to ablation
- May need PPMI
- Surgical

## Surgical Interventions

- Permanent pacing
- CABG (Coronary Artery Bypass Grafting)
- **Aneurysmectomy** – resection of aneurysm: the ballooning portion of ventricular wall.
- **Implantable cardioverter/defibrillator** – for person who has 1 or more episodes of spontaneous sustained ventricular tachycardia or V-Fib not caused by an MI.
- **Open-chest cardiac massage** – for patient in cardiac arrest and CPR, etc. has been unsuccessful. Used only as a last resort d/t possibility of devastating results.

## Valvular Heart Disease

**Prolapse:** falling or dropping down; **Stenosis:** constriction or narrowing; **Regurgitation:** backward flowing

Mitral Stenosis	Aortic Stenosis
<p><b>Patho:</b> Most common cause is from <b>rheumatic carditis</b>; <b>Non-rheumatic causes:</b> atrial tumor, calcium accumulation, and thrombus formation</p> <p><b>S/S:</b> Fatigue, dyspnea on exertion, orthopnea, paroxysmal nocturnal dyspnea, hemoptysis, hepatomegaly, neck vein distention, pitting edema, atrial fibrillation, rumbling, <b>apical diastolic murmur</b></p>	<p><b>Patho:</b> Considered a disease of <b>“wear and tear”</b>; Causes left ventricular outflow obstruction during systole; When surface area of the valve becomes less than or equal to 1cm, surgery is urgently needed</p> <p><b>S/S:</b> angina, syncope on exertion, <b>harsh, systolic cresendodecrescendo murmur</b>; other s/s the same as mitral stenosis</p>



## Valvular Heart Disease Continued

Mitral Regurgitation	Aortic Regurgitation	Mitral Valve Prolapse
<p><b>Patho:</b> Backflow of blood into the left atrium when left ventricle contracts; Results in left atrial and left ventricular dilation and hypertrophy; Most common cause is rheumatic heart disease; Nonrheumatic causes include papillary muscle disease or rupture, ischemic heart disease, infective endocarditis, or a congenital anomaly</p> <p><b>S/S:</b> Palpitations, A-Fib, neck vein distention, pitting edema, high-pitched holosystolic murmur, other s/s same</p>	<p><b>Patho:</b> Aortic valve leaflets do not close properly during diastole allowing regurgitation of blood from the aorta back into the left ventricle during diastole</p> <p>Annulus may be dilated; Left ventricular hypertrophy</p> <p><b>S/S:</b> Palpitations, Dyspnea, Angina, Orthopnea, Sinus Tachycardia, Blowing, descrescendo diastolic murmur</p>	<p><b>Patho:</b> Valvular leaflets enlarge and prolapse into the left atrium during systole; Most clients are asymptomatic; Associated with Marfan's syndrome</p> <p><b>S/S:</b> Atypical chest pain,; dizziness; syncope; palpitation; atrial tachycardia; ventricular tachycardia; systolic click</p>

### **Valvular Heart Disease Assessment**

- History of rheumatic fever, infective endocarditis, or IV drug use
- Activity tolerance, angina, dyspnea, or palpitations
- VS, edema, palpate and auscultate the heart and lungs, palpate peripheral pulses
- Echocardiogram is definitive test for diagnosis
- TEE or TTE
- Chest xray changes
- ECG (atrial fib. common)

### **Non-Surgical Management**

- **Drug therapy**
  - Diuretics, beta blockers, digoxin, and oxygen
  - Cautious use of nitrates
  - Vasodilators
  - Maintain NSR
  - Anticoagulation
  - Rest
- **Noninvasive heart valve reparative procedures**
  - Balloon valvuloplasty – for stenotic Mitral and Aortic valves; noncalcified mitral

## Surgical Management

- **Invasive heart valve reparative procedures**
  - Direct (open) commissurotomy – cardiopulmonary bypass during open heart surgery.
  - Mitral valve annuloplasty (reconstruction) – TOC for mitral insufficiency.
- **Heart valve replacement procedures**
  - Pre-op care – No anticoagulants for at least 72 hrs. before procedure; ALL dental work must be done prior to surgery.
  - Post-op care – similar to CABG

**NOTE:** Patient's with Valvular heart disease HX requires antibiotic before and after all invasive procedures and tests.

## Infective Endocarditis

Patho	S/S	Patient-Centered Collaborative Care
<p>Infection of the lining membrane of the heart</p> <p>Most commonly caused by Strep or Staph</p> <p>IV drug abusers, previous valve replacement, systemic infection, structural cardiac defects</p> <p><b>Possible portals of entry:</b> oral cavity, skin rashes, lesions, infections, surgery, IV</p>	<p>Fever associated w/chills, night sweats, malaise, and fatigue; Anorexia &amp; Wt. loss;</p> <p>Cardiac murmur (newly developed or <math>\Delta</math> in existing);</p> <p>Development of heart failure;</p> <p>Evidence of systemic embolization; Petechiae;</p> <p>Splinter hemorrhages;</p> <p>Osler's nodes (on palms of hands &amp; soles of feet);</p> <p>Janeway's lesions (flat, reddened maculae on hands &amp; feet);</p> <p>Positive blood cultures</p>	<p><b>Diagnostic Test:</b> a positive blood culture is prime test.</p> <p>Echocardiography, TEE</p> <p><b>Interventions:</b> Antimicrobials are main TX w/choice of drug dependent on specific organism involved – usually given IV lasting 4 to 6 weeks.</p> <p>For bacterial cases – PCN or Cephlosporins; Continually assess for HF (rapid pulse, fatigue, cough, dyspnea); use aseptic technique; adequate rest</p> <p><b>Surgical:</b> Removal of infected valve; repair or remove congenital shunts; repair injured valves &amp; chordae tendineae; draining abscess in heart</p>

## Pericarditis

Patho	S/S	Treatment
<p><b>Acute pericarditis</b>            Infective organisms            Dressler's syndrome            Post-pericardiotomy syndrome            Acute exacerbations of connective tissue disease</p> <p><b>Chronic constrictive pericarditis</b>            TB            Radiation therapy            Trauma            Renal failure            Metastatic cancer</p>	<p style="text-align: center;"><b>Acute</b></p> <p>Substernal chest pain radiating to the left side of the neck, shoulder, or the back.</p> <p>Pain is aggravated by inspiration, coughing, and swallowing</p> <p>Pain worse in the supine position and relieved by sitting up and leaning forward; Pericardial friction rub; Elevated white count with fever; Spiked T-waves</p> <p>Frequently have atrial fibrillation            Pericardial effusion</p> <p style="text-align: center;"><b>Chronic</b></p> <p>Signs of right-sided heart failure            JVD; Hepatic engorgement;            Dependent edema</p>	<p><b>Pain management:</b> NSAID's, Corticosteroid therapy;            Antibiotics and possible pericardial drainage; Chemo radiation, or hemodialysis</p> <p><b>Pericardiectomy:</b>            Pericardial effusion            Cardiac tamponade (swelling of blood)</p> <p><b>Emergency Care Acute Cardiac Tamponade:</b> Occurs in 15% of clients with acute pericarditis            JVD; Lean pt. forward            Paradoxical pulse            Decreased cardiac output            Muffled heart sounds            Hypotension</p> <p><b>TREATMENT:</b> Pericardiocentesis</p>

## Myocarditis

Patho	S/S	TX
<p>Inflammation of the heart not related to coronary artery disease or MI</p> <p>Most often caused by a virus; may also be a bacterial or fungal infection</p> <p>Lupus erythematosus may also cause the disorder</p> <p>Causes weakening of the heart muscle and decrease in cardiac contractility</p> <p>A major cause of heart transplantation in the U.S.</p>	<p>Chest pain</p> <p>Fatigue</p> <p>Dyspnea</p> <p>Elevated SED rate</p> <p>Elevated WBC</p> <p>Elevated levels of antiviral antibodies</p>	<p>Antibiotics</p> <p>Control heart failure</p> <p>Heart transplantation</p>

## Rheumatic Carditis (Endocarditis)

Patho	S/S	TX
<p>Develops after an upper respiratory tract infection with group A beta strep in 40% of the clients that have had rheumatic fever;</p> <p>Affects all layers of the heart; Causes inflammatory lesions (<i>Aschoff's bodies</i>) of the heart</p> <p>Results in impaired cardiac contraction of myocardium, thickening of the pericardium and valvular damage</p>	<p>Tachycardia</p> <p>Cardiomegaly</p> <p><b>Murmur</b></p> <p>Friction rub</p> <p>Precordial pain</p> <p><b>EKG artifact (fuzzy) changes</b></p> <p><b>HF</b> – Right (systemic body) and Left (lungs)</p> <p>Evidence of strep infection</p>	<p>Primary prevention (get treated)</p> <p>Penicillin</p> <p>Erythromycin if allergic to PCN</p> <p>Antibiotic prophylaxis</p>

## Cardiomyopathy

- Pathophysiology
  - Subacute or chronic disease of cardiac muscle
  - Four categories based on dysfunction in structure or function
    - Dilated
    - Hypertrophic
    - Restrictive
    - Arrhythmogenic right ventricular



## Cardiomyopathy Categories

Dilated Cardiomyopathy	Hypertrophic Cardiomyopathy	Restrictive Cardiomyopathy	Arrhythmogenic Right Ventricular Cardiomyopathy
<p>DCM: more common seen</p> <p>Normal ventricular wall thickness but a dilation of both ventricles and impairment of systolic function</p> <p><b>Symptoms:</b> dyspnea, fatigue, and palpitation</p> <p><b>Causes:</b> alcohol abuse, chemotherapy, infection, inflammation, poor nutrition</p>	<p>HCM: 50% of the clients have a single-gene autosomal dominant trait</p> <p><b>Cardinal features:</b></p> <p>ventricular hypertrophy and disarray of the myocardial fibers</p> <p>Stiff left ventricle that results in diastolic filling abnormalities</p> <p>Some clients have no symptoms—sudden death</p> <p>DOE, syncope, dizziness, palpitations</p>	<p>Rarest form</p> <p>Stiff ventricles that result in restricted filling</p> <p><b>Causes:</b> endocardial or myocardial disease</p> <p><b>S/S</b> similar to right and left HF</p> <p>Poor prognosis</p>	<p>Replacement of cardiac tissue with fibrous and fatty tissue</p> <p>May have (L) ventricular involvement also</p> <p>Familial disease</p> <p>Most often seen in young adults</p>

## Cardiomyopathy Care

Assessment	Interventions	Criteria Heart Transplant	Post-Op Transplant Care
<p>DCM—may be asymptomatic for years; left or right ventricular hypertrophy; DOE; orthopnea; palpitations; activity intolerance; Afib is common</p> <p>HCM—DOE; angina; syncope; CP at rest; ventricular dysrhythmias</p>	<p><b>Nonsurgical</b> Drug therapy</p> <p><b>Surgical:</b> Ventriculomyectomy: excision of a portion of hypertrophied ventricular septum to create a widened outflow tract</p> <p>Percutaneous alcohol septal ablation: absolute alcohol injected into the LAD to produce a small septal infarct</p> <p>Heart transplant</p>	<p>Life expectancy less than one year</p> <p>Age less than 65</p> <p>NYHA class III or IV</p> <p>Normal or only slightly increase pulmonary vascular resistance</p> <p>Absence of infection</p> <p>Stable psychosocial status</p> <p>No evidence of drug or alcohol abuse</p>	<p>Monitor for occult bleeding; Monitor for orthostatic B/P;</p> <p>Immunosuppressant therapy; Cardiac and resp assessments;</p> <p>Aseptic technique</p> <p><b>Monitor for signs of rejection:</b></p> <p>SOB; Fatigue; Fluid gain; Abdominal bloating; New bradycardia; Hypotension; A-Fib or Flutter; ↓ activity tolerance; ↓ ejection fraction (late sign)</p> <p>Coronary artery vasculopathy</p>

## CABG

Patho	Candidates	Preop	PostOp
<p>Most common type of cardiac surgery</p> <p>Occluded coronary arteries are bypassed with the client's own venous or arterial blood vessels or synthetic grafts</p> <p>IMA is the graft of choice due to patency rate</p>	<p>Angina greater than 50% occlusion of the left main coronary artery</p> <p>Unstable angina with severe two-vessel or moderate three-vessel disease</p> <p>Ischemia with heart failure</p> <p>Acute MI</p> <p>Signs of ischemia or impending MI after angiography or PTCA</p> <p>Valvular disease</p> <p>Coronary vessels unsuitable for PTCA</p>	<p>May be elective or emergent procedure</p> <p>May be traditional technique or MIS technique</p> <p><b>Pre-op teaching is very important:</b></p> <p>Report pain to the staff</p> <p>T, C, &amp; DB exercises will be expected</p> <p>Early ambulation</p>	<p>Monitor for dysrhythmias and complications</p> <p>Fluid and electrolyte balance</p> <p>Hypotension</p> <p>Hypothermia</p> <p>Hypertension</p> <p><b>Bleeding</b></p> <p>Cardiac tamponade</p> <p>Altered LOC</p> <p><b>Anginal pain</b></p> <p>Transfer from the SCU</p>

## CABG Continued

<b>MIDCAB</b>	<b>Endovascular Vessel Harvesting</b>	<b>Transmyocardial Laser Revascularization</b>	<b>Off-Pump CABG</b>
<p>Minimally invasive direct coronary artery bypass</p> <p>Indicated in clients with a lesion or blockage of the left anterior descending (LAD) artery</p> <p>Left thoracotomy incision is made the fourth rib is removed and the IMA is dissected and attached to the beating heart below the level of the lesion</p>	<p>Donor vessel obtain using endoscope instead of surgical incision</p> <p>Radial artery or leg vein may be used</p>	<p>Clients with unstable angina and inoperable CAD with areas of reversible myocardial ischemia</p> <p>Single lung intubation, left anterior thoracotomy is performed and the heart visualized</p> <p>Laser is used to create long narrow channels through the left ventricular muscle to the left ventricle</p> <p>These channels will eventually allow oxygenated blood to flow during diastole from the ventricle to nourish the heart</p>	<p>CABG without the bypass machine</p> <p>Decreased LOS</p> <p>Decreased mortality rate</p> <p>Decreased risk of infection</p> <p>Decreased cost</p> <p>Increased mastery of surgeon</p> <p>Accessibility of surgery sites</p>

## **Robotic Heart Surgery**

- Small incisions in chest wall
- Ability to reach otherwise inaccessible sites
- Improved depth perception and vision
- Decreased LOS
- Less painful
- Chance of computer failure
- Limited number of skilled surgeons
- Takes longer than traditional surgery

## Pediatric CHF

<b>Patho &amp; Etiology</b>	<b>S/S</b>	<b>Diagnostics</b>	<b>TX</b>
<p>Heart's inability to circulate blood to maintain sufficient cardiac output to meet the metabolic demands of the body.</p> <p><b>Etiology:</b> r/t underlying congenital cardiac defect that causes volume or pressure overload, but possibly from acquired heart disease.</p>	<p>Mild Tachypnea (70-100 BPM) @ rest; difficult feeding (longer than usual, no satisfaction); Children: ↓ appetite; diaphoresis; ↓ energy</p>	<p>Clinical HX; PE; CXR; ECG; ECHO.</p>	<p>Digoxin; Diuretics; Vasodilators like Hydralazine, Captopril, Enalapril</p>

## ASD, VSD, PDA Overview

ASD	VSD	PDA
Atrium <b>smaller</b> than Ventricles; opening; Give <b>Diuretics, Digoxin</b> for s/s of HF	Ventricles are <b>bigger</b> ; Loud, harsh, systolic murmur; palpable thrill; diastolic murmur w/gallop rhythm poss.; risk for HF d/t hypertrophy of rt. ventricle; poss. bacterial endocarditis; Give <b>Diuretics, Digoxin</b> , ACE Inhibitors	Moves de-O <sub>2</sub> blood into body; Bounding pulses; Widened pulse pressure; Continuous murmur w/machine sound; Give <b>Indocin</b> → constricts ductus
<b>↑</b> Pulmonary blood flow; left to right shunting; failure to thrive (growth failure, ↓ wt. gain; ↑ sweating on exertion; fatigue; cardiac murmur; dyspnea; coughing; ↑ RR; nasal flaring; Provide small, frequent meals q 3 hours; burp; nipple-feeding; semi-upright position; rest; <b>NO crying</b>		

## Patent Ductus Arteriosus (Left-to-Right Shunting)

Patho	Altered Hemodynamics	Manifestations	Therapeutic Management
<p>5% to 10% of all congenital heart lesions</p> <p>Caused by failure of fetal ductus arteriosus to close completely after birth – normal closure within 24 to 72 hours after birth d/t ↓ prostaglandin levels and ↓ BP in ductus lumen</p>	<p>D/T ↓ in pulmonary vascular resistance and failure of the ductus arteriosus to close, ↑ systemic pressure moves satuated blood from aorta into pulmonary arteries (left-to-right shunt), the lungs, and left side of heart causing both ↑ left sided cardiac workload and ↑ pulmonary blood flow</p>	<p>Continuous murmur – machinery like sound;</p> <p>Widened pulse pressure; bounding pulses; cardiac enlargement</p>	<p>Administration of Indocin, a PG inhibitor that constricts the ductus;</p> <p>Monitor respiratory status, renal function, and growth;</p> <p>Interventional Cardiac Catheterization – a coil is placed to occlude the ductus;</p> <p>Ligation of ductus via left thoracotomy, usually within the 1<sup>st</sup> year of life</p>



## Atrial Septal Defect

Patho	Altered Hemodynamics	Manifestations	Therapeutic Management
<p>5% to 10% of cardiac lesions, seen more often in girls</p> <p>Abnormal opening between the atria; 3 types predominate: Ostium Secundum, Ostium Primum, Secundum Venosus</p>	<p>↓ right ventricular compliance (ease of ventricular filling during diastole) compared to left ventricular compliance leads to left-to-right shunting across the abnormal septal opening; right atrium is enlarged and pulmonary blood flow ↑</p>	<p>May be asymptomatic; depending on size of lesion; fatigue, dyspnea on exertion; palpitations; atrial dysrhythmias; recurrent respiratory infections r/t ↑ pulmonary blood flow; systolic murmur from ↑ blood flow across the pulmonary valve; diastolic murmur w/large shunting; mitral valve regurgitation is possible; HF may develop during young adulthood, if not repaired; risk for stroke</p>	<p>Diuretics and Digoxin for signs of HF;</p> <p>Antidysrhythmics for atrial dysrhythmias;</p> <p>Interventional Cardiac Cath – Daily low-dose ASA for 6 months after procedure;</p> <p>Complications: Dysrhythmias, postpericardiotomy syndrome (inflammation w/pericardial effusion)</p>

## Ventricular Septal Defect

<b>Patho</b>	<b>Altered Hemodynamics</b>	<b>Manifestations</b>	<b>Therapeutic Management</b>
15% - 20% of cardiac defects; abnormal opening between the ventricles; 3 types according to location: conoventricular, atrioventricular(AV) canal, muscular, depending on size, complete absence of the septum results in a common ventricle; Most common type of cardiac defect	↓ in pulmonary vascular resistance compared to systemic vascular resistance in the weeks after birth results in left-to-right shunting through the VSD. ↑ pulmonary blood flow, pulmonary HTN and progressive pulmonary vascular disease can occur over time	Loud, harsh systolic, murmur, varies in intensity and duration depending on degree of shunting and size of defect, palpable thrill, diastolic murmur and gallop rhythm may be present. HF may occur w/moderate to large defects	Diuretics, Digoxin (Inotropic – forceful contraction), and ACE inhibitors

## Coarctation of the Aorta

Patho	Altered Hemodynamics	Manifestations	Therapeutic Management
8% to 10% of cardiac defects; aorta is constricted near the ductus arteriosus insertion location; associated w/bicuspid aortic valve that can later become stenotic	Narrowing of the aortic structure obstructs the left ventricular output, ↑ afterload to left ventricle, blood supply is ↓ in the abdominal organs and the ↓ periphery, left ventricular pressure ↑ aortic pressure is high proximal to constriction and low distal; pulmonary edema can occur. If coarctation is mild, collateral blood supply can develop to channel blood past the constriction.	Left-sided HF w/low cardiac output, poor lower extremity peripheral perfusion, metabolic acidosis, shock; If PDA present – right-to-left shunting w/differential cyanosis (color and oxygenation differential between upper and lower extremities); Systolic murmur accompanied by ejection click or thrill	Diuretics and Digoxin

**Tetrology of Fallot**  
**(Cyanotic Lesions w/Decreased Pulmonary Blood Flow)**

<b>Patho</b>	<b>Altered Hemodynamics</b>	<b>Manifestations</b>	<b>Therapeutic Management</b>
5% - 10% of congenital cardiac defects; most frequently seen cyanotic lesion; constellation of lesions results from malalignment of	Equal right and left sided ventricular pressures r/t pulmonary artery obstruction and size of VSD, desaturated blood enters the	Onset and severity of s/s are r/t extent of obstructed pulmonary blood flow, which causes the right to left shunting; if lesions are mild,	PGE, infusion to maintain patency of ductus arteriosus and blood flow to lungs, management of hypercyanotic episodes, TX of iron deficiency

ventricular septum during fetal development – VSD, right ventricular outflow tract obstruction pulmonary stenosis, overriding of the aorta, right ventricular hypertrophy

systemic system by shunting right to left across the VSD, or into the overriding aorta

shunting is ↓ and saturations are mildly ↓; cyanosis, extreme fatigue, hypercyanotic episodes, chronic hypoxemia; Harsh systolic murmur w/palpable thrill, boot-shaped heart on radiography

anemia

## Cardiovascular Pharmacology

<b>Beta Blockers</b> <b>"LOL"</b>	<b>Calcium Channel Blockers</b> <b>"Pine"</b> or <b>"Zem"</b>	<b>Nitrates</b>	<b>Antiarrhythmics</b>
atenolol labetalol metoprolol nadolol propranolol	diltiazem felodipine <b>nicardipine</b> —50 mg/250 mL with dose range 5-25 mg/hr nifedipine verapamil	isosorbide dinitrate isosorbide mononitrate nitroglycerin—50 mg/250 mL with dose range 0.5-5 mcg/kg/min or 5-20 mcg/min	Chart 36-2, Vaughn-Williams Classification - System that is commonly used to classify anti-dysrhythmic drugs. Based on the electrophysiologic effect of particular drugs on the action potential. <b>amiodarone</b> —450 mg/250 mL with dose range 150 mg IV bolus over 10 minutes then 1 mg/min for 6 hours then decrease to 0.5 mg/min for maintenance dose

<b>Adrenergics</b> <b>“mine” or “phrine”</b>	<b>Anticoagulants</b> <b>“rin”</b>	<b>Statins</b> <b>“statin”</b>	<b>Antiplatelet Agents</b>
<p><b>dobutamine</b>—250 mg/250 mL with dose range 2-20 mcg/kg/min</p> <p><b>dopamine</b>—400 mg/250 mL with dose range 2-20 mcg/kg/min</p> <p><b>epinephrine</b>—2 mg/250 mL with dose range 25-300 mcg/kg/min</p> <p><b>norepinephrine</b>—8 mg/250 mL with dose range 0.05-0.4 mcg/kg/min</p>	<p>Heparin - aPTT</p> <p>Warfarin – PT/<u>INR</u></p> <p>enoxaparin</p>	<p>atorvastatin</p> <p>fluvastatin</p> <p>lovastatin</p> <p>pravastatin</p> <p>rosuvastatin</p> <p>simvastatin</p>	<p>dipyridamole</p> <p>clopidogrel</p> <p>ticlopidine</p>

**Thrombolytic Agents “ase”**

alteplase  
reteplase  
streptokinase  
tenecteplase  
urokinase

**Precautions**—major surgery within 10 days

**Nsg implications**—begin ASAP after onset of symptoms; monitor VS; assess for bleeding; assess neuro status; monitor EKG—with reperfusion, will have vent dysrhythmias with cessation of pain

**Teaching**—purpose of med

**Others**

isoproterenol  
calcium chloride  
furosemide  
bumetanide



## **Stages of MI**

- Acute Injury (ST elevation)
- Necrosis (Q waves)
- Resolution (scar tissue): persistent Q-waves or flipped T-waves

## **ECG Lead Groups and Cardiac Anatomy**

- Each lead group or area is perfused by its own coronary artery
- Two main division of the coronary arteries
  - Right coronary artery (RCA)
  - Left main—divides into the left anterior descending (LAD) and circumflex

## ECG Lead Groups

- Septal
- Anterior
- Lateral
- Inferior
- You may see changes in more than 1 lead group!

## Septal Leads

- V1, V2
- Look at the septum between the ventricles
- Perfused by the RCA and LAD

### **Anterior Leads**

- V3 and V4
- Look at the anterior portion of the left ventricle
- Perfused by the LAD

### **Lateral Leads**

- V3 and V4
- Look at the anterior portion of the left ventricle
- Perfused by the LAD

## **Inferior Leads**

- II, III, and aVF
- Look at the right side of the heart
- Perfused by the RCA
- This area is innervated by the same group of nerves that innervate the stomach
- Nausea, vomiting, and hiccups

## **Widow Maker**

- Caused by an occlusion of the left main
- Blocks both the LAD and LCX
- This is called an anterolateral MI
- Almost all perfusion to the left ventricle is altered

## STEMI

The criteria for a STEMI is ST elevation in 2 or more contiguous leads

<b>I</b> <b>Lateral</b>	<b>aVR</b>	<b>VI</b> <b>Septal</b>	<b>V4</b> <b>Anterior</b>
<b>II</b> <b>Inferior</b>	<b>aVL</b> <b>Lateral</b>	<b>V2</b> <b>Septal</b>	<b>V5</b> <b>Lateral</b>
<b>III</b> <b>Inferior</b>	<b>aVF</b> <b>Inferior</b>	<b>V3</b> <b>Anterior</b>	<b>V6</b> <b>Lateral</b>

## **Electrical Reciprocity**

- Many cardiac areas are electrically reciprocal
- Example: If the leads in the inferior area show ST elevation, the lateral leads will show ST depression