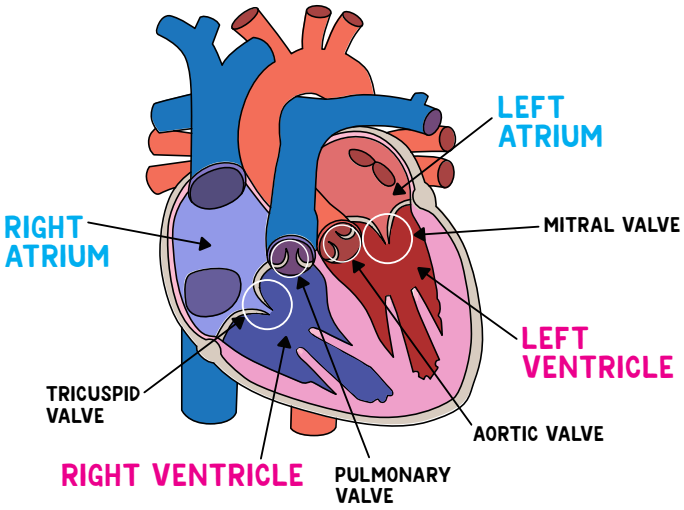
CARDIAC SYSTEM OVERVIEW

THERE ARE 4 CHAMBERS OF THE HEART:



ATRIUMS : BLOOD RECIEVERS

RIGHT ATRIUM: receives blood from **body**
LEFT ATRIUM: receives blood from **lungs**

VENTRICLES : BLOOD PUMPERS

RIGHT VENTRICLE: pumps blood to **lungs**
LEFT VENTRICLE: pumps blood to **body**

VALVES: prevent backflow

ATRIOVENTRICULAR VALVES

Prevent backflow from **ventricles** to **atriums**

TRICUSPID VALVE
Between right atrium & right ventricle

MITRAL VALVE
Between left atrium & left ventricle

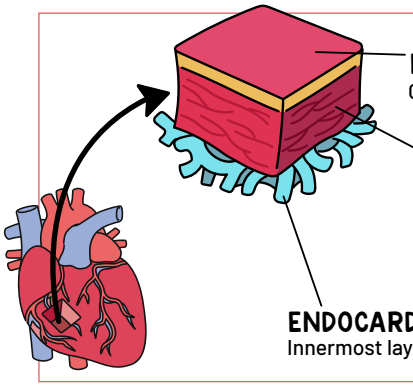
SEMILUNAR VALVES

Prevent backflow from **arteries** to **ventricles**

PULMONARY VALVE
Between right ventricle & pulmonary artery

AORTIC VALVE
Between left ventricle & aorta

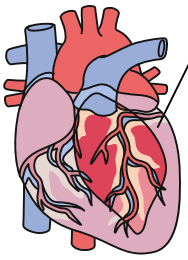
LAYERS OF THE HEART



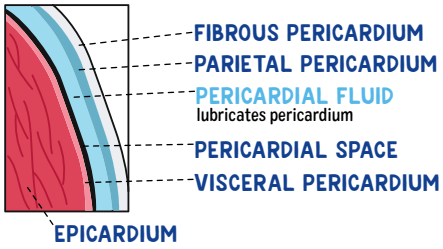
EPICARDIUM
Outermost layer of heart

MYOCARDIUM
Middle muscular layer of the heart (thickest layer)
THINK MUSCLES CONTRACT
↳ responsible for **contractility**

ENDOCARDIUM
Innermost layer of the heart



PERICARDIUM
Protective, fluid filled sac that covers the heart



CARDIAC TERMS

CARDIAC OUTPUT (CO)

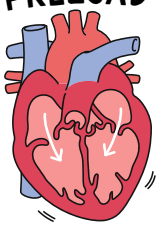
Amount of blood ejected from the heart in one full minute

NORMAL CO: 4–8L/ MIN

FORMULA:

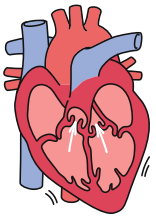
HR (Heart Rate) x **SV** (Stroke Volume) = **CO** (Cardiac Output)

PRELOAD



Amount of blood in the ventricles before contracting

AFTERLOAD



Resistance the left ventricle must overcome to pump out blood into circulation

STROKE VOLUME (SV)

Amount of blood ejected from the heart in each beat

NORMAL SV: 50–100 ML/ MIN

HEART RATE (HR)

Amount of time heart beats per minute

NORMAL HR: 60–100 BPM

EJECTION FRACTION (EF)

Amount of blood pumped out from left ventricle with each contraction

NORMAL EF: 50–70%

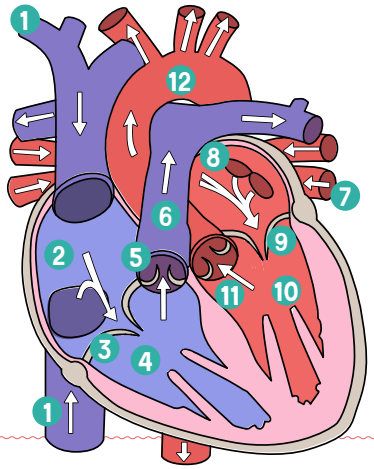
CONTRACTILITY

Force and strength of contraction of the heart muscle

↑ CONTRACTILITY = ↑ SV
A stronger heart contraction causes more blood output

CARDIAC FUNCTIONING

BLOOD FLOW THROUGH THE HEART



RIGHT

DEOXYGENATED BLOOD

① SVC/IVC
② Right Atrium
③ Tricuspid Valve
④ Right Ventricle
⑤ Pulmonic Valve
⑥ Pulmonary Artery

Blood to **LUNGS**

LEFT

OXYGENATED BLOOD

⑦ Pulmonary Vein
⑧ Left Atrium
⑨ Mitral/Bicuspid Valve
⑩ Left Ventricle
⑪ Aortic Valve
⑫ Aorta

Blood to **BODY**

BLOOD VESSELS

ARTERIES

Carry **oxygenated** blood from heart to tissues

THINK **A** FOR **AWAY**

VEINS

Carry **deoxygenated** blood to heart

THINK **V** FOR **VISIT**

EXCEPTIONS

PULMONARY ARTERY
Carries **deoxygenated** blood from the heart to the lungs

PULMONARY VEIN
Carries **oxygenated** blood from the lungs to the heart

CONDUCTION SYSTEM

Electrical impulses generated to regulate heart muscle contraction

REPOLARIZATION= RELAX

DEPOLARIZATION= CONTRACT

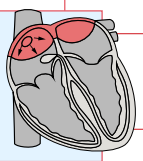
SA NODE

Sends impulse to contract atrium

BEATS 60–100 BPM

"PACEMAKER" OF THE HEART

P WAVE



ATRIAL DEPOLARIZATION **STARTS**

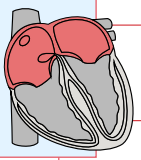
AV NODE

Creates delay so atria can fully empty into ventricles

BEATS 40–60 BPM

"GATEKEEPER" OF THE HEART

PR INTERVAL



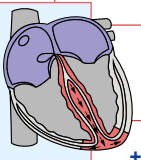
ATRIAL DEPOLARIZATION **COMPLETE**

BUNDLE OF HIS

Carries impulses from AV node to bundle branches

BEATS 20–40 BPM

QRS COMPLEX



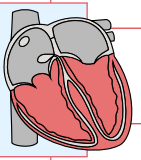
VENTRICULAR DEPOLARIZATION **STARTS**

+ ATRIAL REPOLARIZATION

BUNDLE BRANCHES

Carries impulses to right and left ventricles

BEATS 20–40 BPM



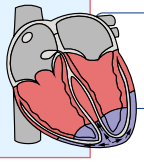
VENTRICULAR DEPOLARIZATION **COMPLETE**

PURKINJE FIBERS

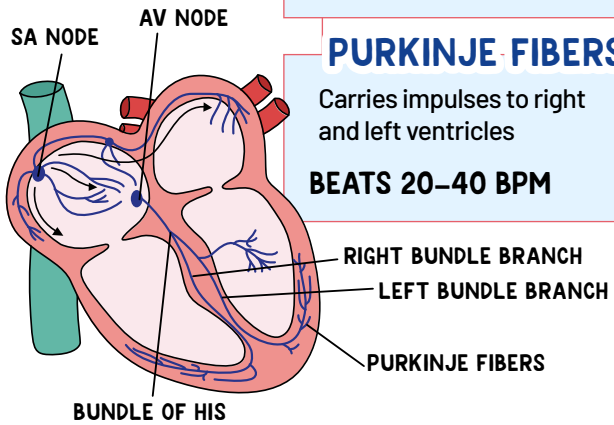
Carries impulses to right and left ventricles

BEATS 20–40 BPM

T WAVE

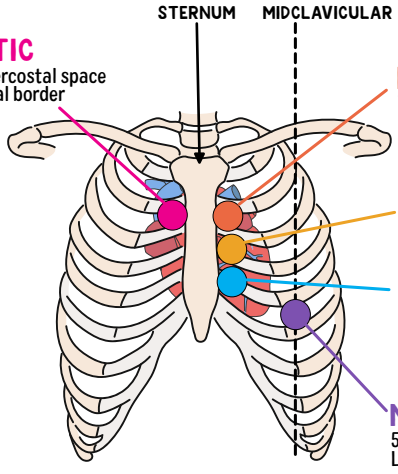


VENTRICULAR REPOLARIZATION



CARDIAC ASSESSMENT

AUSCULTATING HEART SOUNDS



S1 "LUB"
- Beginning of SYSTOLE — Ventricles contracting
- Closure of **tricuspid** & **mitral** valves

S2 "DUB"
- End of DIASTOLE — Ventricles relaxing
- Closure of **aortic** & **pulmonic** valves

ABNORMAL HEART SOUNDS

S3	Rapid ventricular filling	Sounds like "lub-dub-ta" (VENTRICULAR GALLOP)
S4	Blood forcing into stiff ventricle	Sounds like "ta-lub-dub" (ATRIAL GALLOP)

CARDIAC MEASUREMENTS

BLOOD PRESSURE (BP)

Pressure of blood pushing against the walls of the arteries

- **SYSTOLIC BLOOD PRESSURE (SBP)**: Pressure in the arteries when ventricles **contract**
- **DIASTOLIC BLOOD PRESSURE (DBP)**: Pressure in the arteries when ventricles **relax**

MEAN ARTERIAL PRESSURE (MAP)

Average pressure in arteries during one cardiac cycle (systole & diastole)

★ CONSIDERED BETTER INDICATOR OF PERFUSION TO VITAL ORGANS THAN SYSTOLIC BLOOD PRESSURE

NORMAL MAP: 70–100 MMHG

FORMULA:

$$MAP = \frac{SBP + (2 \times DBP)}{3}$$

EXAMPLE

BP= 97/50

$$\frac{SBP + (2 \times DBP)}{3} = \frac{95 + (2 \times 50)}{3} = \text{ANSWER } 65$$

CARDIAC BIOMARKERS

TROPONIN (TRP)

Proteins released into blood when heart muscle has been damaged

MOST COMMONLY USED TO DIAGNOSE MI

NORMAL: <0.04 NG/ML

CREATINE KINASE MYOCARDIAL BAND (CKMB)

Enzyme released into blood following tissue damage to the heart

NOT AS SPECIFIC AS TROPONIN, PREDICTIVE OF MI

NORMAL: <5 NG/ML

BRAIN NATRIURETIC PEPTIDE (BNP)

Peptide released from cardiomyocytes when ventricles overfill and stretch

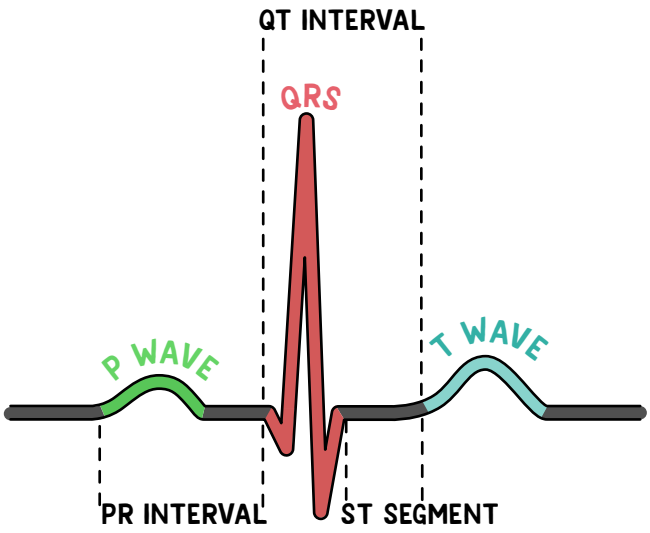
USED TO DETECT HEART FAILURE

NORMAL: <100 PG/ML | **>900= SEVERE HF**

DIAGNOSTICS

- **EKG:** measures electrical activity of heart
- **ECHO:** measures ejection fraction & cardiac output + assesses valve function
- **CARDIAC CATH:** measures pressure & blood flow in the heart

EKG BASICS



P WAVE

Atrial **depolarization** (both atria contract)

QRS COMPLEX

Ventricular **depolarization** & atrial **repolarization**
(both ventricles **contract**, both atria **relax**)

T WAVE

Ventricular **repolarization** (both ventricles **relax**)

NORMAL VALUES

PR INTERVAL: 0.12 - 0.20
QRS COMPLEX: 0.06 - 0.12
QT INTERVAL: 0.35 - 0.45

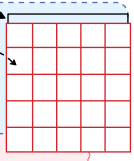
REPOLARIZATION= RELAX
filling with blood

DEPOLARIZATION= CONTRACT
pumping blood

INTERPRETING AN EKG

KEY

1 BIG BOX= 0.2 secs
1 SMALL BOX= 0.04 secs
1 BIG BOX= 5 SMALL BOXES

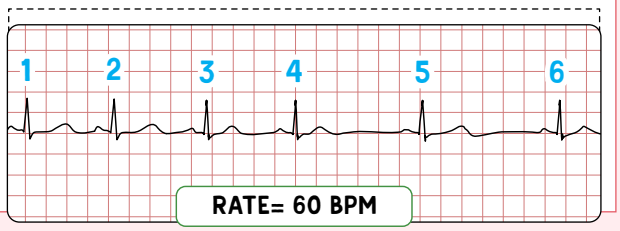


1 IDENTIFY THE RATE

6 SECOND METHOD — BEST FOR IRREGULAR RHYTHMS

Count # of R's in 6 second strip & multiply by 10

There are 30 BIG BOXES in a 6 second strip

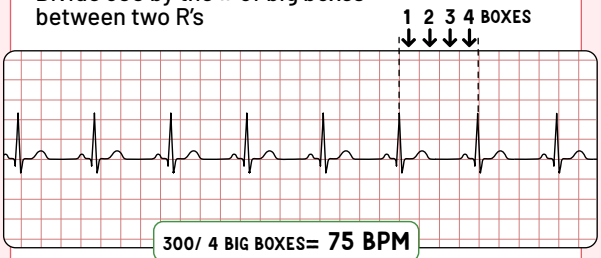


RATE= 60 BPM

BOX METHODS — BEST FOR REGULAR RHYTHMS

BIG BOX METHOD

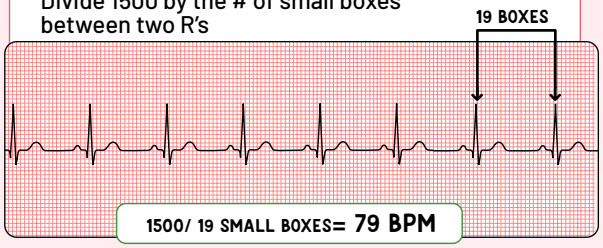
Divide 300 by the # of big boxes between two R's



300/ 4 BIG BOXES= 75 BPM

SMALL BOX METHOD

Divide 1500 by the # of small boxes between two R's



1500/ 19 SMALL BOXES= 79 BPM

2 IDENTIFY THE RHYTHM

Are the R-R intervals consistent?

(Check by assessing if the # of boxes between each R are the same)

SAME # OF BOXES= REGULAR
BOX # VARIES= IRREGULAR

3 IDENTIFY THE P WAVE

① Are the P waves present & upright?
② Is there a P wave for every QRS complex?

4 MEASURE PR INTERVAL

NORMAL: 0.12–0.20

>0.20 may indicate heart block

5 MEASURE QRS COMPLEX

NORMAL: 0.06–0.12

WIDE QRS (>0.12) usually seen in:
- Electrolyte imbalances
- PVC's
- Drug toxicity

6 IDENTIFY YOUR FINDINGS!

CARDIAC RHYTHMS

NORMAL SINUS RHYTHM

The rhythm of a healthy heart

RATE:	60-100 bpm
RHYTHM:	Regular
P-WAVE:	Upright & before every QRS
PR INTERVAL:	Normal
QRS:	Normal

SINUS BRADYCARDIA

Slower than normal heart rate

RATE:	<60 bpm
RHYTHM:	Regular
P-WAVE:	Upright & before every QRS
PR INTERVAL:	Normal
QRS:	Normal

CAUSES:

- →Vagal stimulation
- →Athletes
- →Medications (CCB, Digoxin, beta blockers)

CONSIDERED NORMAL
Athletes have a lower resting heart rate due to the heart muscle being stronger & pumping more efficiently

SYMPTOMS:

- →Syncope
- →Confusion
- →Fatigue

May be completely ASYMPTOMATIC

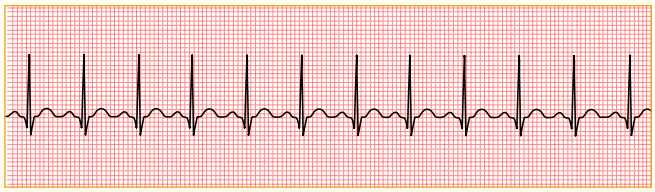
TREATMENT:

If symptomatic:
- →Atropine
- →Transcutaneous pacing

★ If patient is **ASYMPTOMATIC** treatment may not be required

SINUS TACHYCARDIA

Faster than normal heart rate



RATE:	>100 bpm
RHYTHM:	Regular
P-WAVE:	Upright & before every QRS
PR INTERVAL:	Normal
QRS:	Normal

CAUSES:

- →Emotional distress
- →Exercise
- →Fever
- →Severe bleeding/ shock
- →Hyperthyroidism
- →Stimulants (Anticholinergics, cocaine, caffeine)

SYMPTOMS:

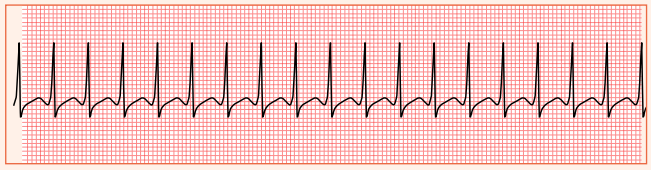
- →Palpitations
- →Shortness of breath
- →Dizziness
- →Headache

TREATMENT:

Find & treat underlying cause!
- →Beta blockers or CCB (if symptomatic)
- →NSAIDs (for fever)
- →Fluid resuscitation (for hypovolemic shock)

SUPRAVENTRICULAR TACHYCARDIA

Sudden rapid heart rate that originates in the atria



RATE:	151-200 bpm
RHYTHM:	Regular
P-WAVE:	Undetectable (hidden in t waves)
PR INTERVAL:	Normal
QRS:	Narrow

CAUSES:

- →Emotional Stress
- →Stimulants

Often triggered by PREMATURE BEATS

SYMPTOMS:

- →Palpitations
- →Shortness of breath
- →Chest pain
- →Syncope

TREATMENT:

- →Vagal maneuver
- →IV Adenosine

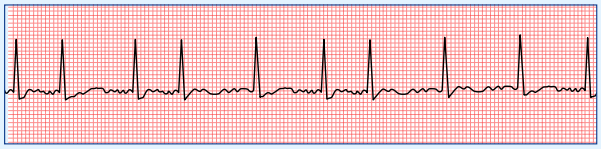
2 DOSES MAX
Dosing starts by giving **6mg** and then **12mg** if unsuccessful
Given FAST with flush immediately after

CARDIAC RHYTHMS

ATRIAL FIBRILLATION & ATRIAL FLUTTER

ATRIAL FIBRILLATION

Abnormal electrical in the atria cause "quivering" or "fibbing"

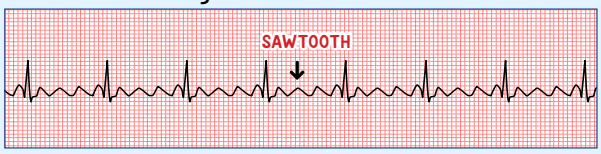


RATE:	Controlled: <100 Uncontrolled: >100
RHYTHM:	Irregularly irregular
P-WAVE:	Unidentifiable
PR INTERVAL:	Unmeasurable
QRS:	Narrow

MAIN DIFFERENCE: A-fib's rhythm is erratic & chaotic while a-flutter is organized (mostly) but atrial rate is still fast

ATRIAL FLUTTER

Similar to afib but with "flutter waves" & atrial rate is regular **most** of the time



RATE:	Controlled: <100 Uncontrolled: >100
RHYTHM:	Regular or irregular
P-WAVE:	Sawtooth flutter waves
PR INTERVAL:	Unmeasurable
QRS:	Regular

CAUSES:

- →Coronary artery disease
- →Heart Failure
- →COPD
- →Hypertension
- →Hyperthyroidism

SYMPTOMS

- →Palpitations
- →Shortness of breath
- →Dizziness
- →Chest pain
- →Anxiety

May be completely **ASYMPTOMATIC**

TREATMENT

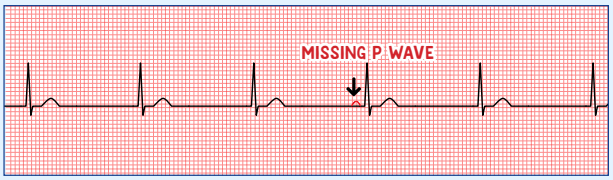
- →Oxygen
- →Cardioversion
  - **SYNCED** shock to attempt to restore to normal rhythm

MEDICATIONS

- →Beta blockers (Metoprolol)
- →Calcium channel blockers (Cardizem)
- →Antiarrhythmics (Amiodarone, Digoxin)
- →Blood thinners
  - Increased risk of **BLOOD CLOTS**

JUNCTIONAL RHYTHMS

SA node fails to initiate impulse, so heart rate originates from AV node or His Bundle



RATE:	Brady: <40 Regular: 40-60 Accelerated: 60-100
RHYTHM:	Regular
P-WAVE:	Inverted or absent ← MAIN SIGN USED FOR IDENTIFYING
PR INTERVAL:	Unmeasurable
QRS:	Narrow

CAUSES:

- →Digoxin toxicity **MOST COMMON**
- →Sinus node dysfunction
- →Carditis
- →Cardiac surgery
- →Myocardial infarction

SYMPTOMS:

- →Weakness
- →Fatigue
- →Chest pain
- →Anxiety
- →Dizziness

TREATMENT:

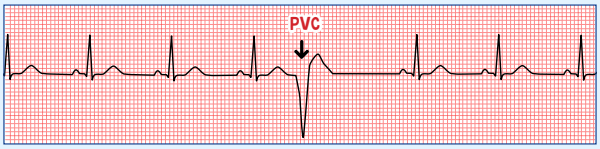
Find & treat underlying cause!

- →Usually no treatment necessary
- →Atropine if rate becomes too slow

PVC'S (Premature Ventricular Contractions) & PAC'S (Premature Atrial Contractions)

PVC'S (Premature Ventricular Contractions)

Extra heartbeats that originate from the **ventricles**

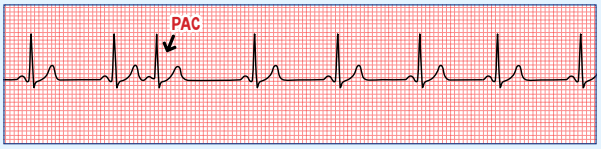


CHARACTERISTICS:

- ▸ Big, wide, & UGLY
- ▸ No p wave before

PAC'S (Premature Atrial Contractions)

Extra heartbeats that originate from the **atria**



CHARACTERISTICS:

- ▸ Small & narrow
- ▸ Compensatory pause after

CAUSES:

- →Electrolyte imbalance
- →Stimulants or stress
- →Myocardial infarction
- →Heart failure
- →Cardiomyopathy

SYMPTOMS

- →May be asymptomatic
- →May feel like heart "skipped a beat"

NOTIFY MD IMMEDIATELY if frequency increases or chest pain is present

TREATMENT

Find & treat underlying cause!

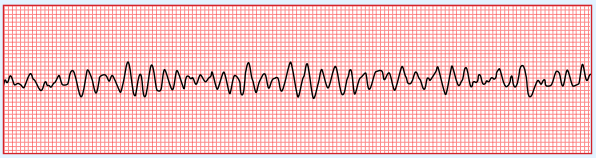
IF SYMPTOMATIC

- →Correct electrolyte imbalances
- →Avoid stimulants
- →Assess for pain

CARDIAC RHYTHMS

VENTRICULAR FIBRILLATION

Ventricles contract in a very rapid and uncoordinated manner



RATE:	Rapid & disorganized
RHYTHM:	Irregular
P-WAVE:	Not visible
PR INTERVAL:	Unmeasurable
QRS:	Unmeasureable

CAUSES:

- Myocardial infarction
- Electrolyte imbalance
- Drug toxicity/ overdose
- Electrical shock
- Hypothermia
- Untreated Vtach

SYMPTOMS: MEDICAL EMERGENCY

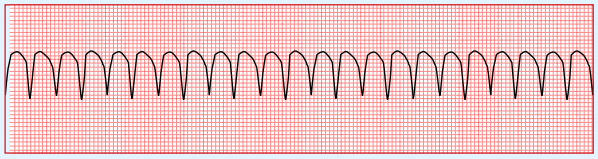
- Loss of consciousness
- Most likely no pulse or blood pressure
- Agonal breathing

TREATMENT:

- CPR and defibrillator
- Follow ACLS protocol (See ACLS & BLS protocol sheet)

VENTRICULAR TACHYCARDIA

Abnormal electrical impulse causing ventricles to contract at very fast rate



RATE:	100-250 bpm
RHYTHM:	Regular
P-WAVE:	Not visible
PR INTERVAL:	Unmeasurable
QRS:	Wide

CAUSES:

- Myocardial infarction
- CAD
- Heart Failure
- Electrolyte imbalance
- Digoxin toxicity
- Stimulants

SYMPTOMS: MEDICAL EMERGENCY

- Palpitations and SOB
- Chest pain
- Loss of conciousness

MAY BE ASYMPTOMATIC but will **become** symptomatic if sustained

TREATMENT:

PULSELESS

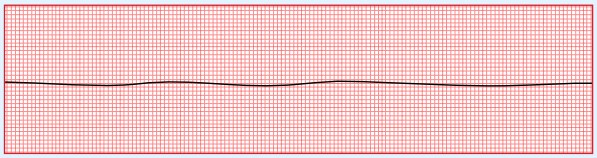
- CPR and defibrillator
- Follow ACLS protocol

STABLE WITH PULSE

- IV Amiodarone
- Synchronized cardioversion

ASYSTOLE/ FLATLINE

Heart stops beating entirely



RATE:	
RHYTHM:	
P-WAVE:	
PR INTERVAL:	
QRS:	

NONE

There is **NO** electrical activity present!

CAUSES:

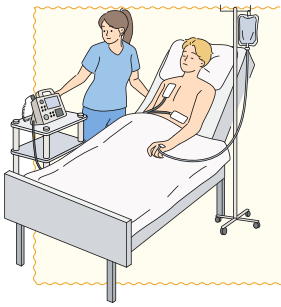
- Myocardial infarction
- Electrolyte imbalance
- Drug toxicity/ overdose
- Electrical shock
- Hypothermia
- Untreated Vtach

SYMPTOMS: MEDICAL EMERGENCY

- Loss of consciousness
- Agonal breathing or apnea
- No pulse

TREATMENT: NOT A SHOCKABLE RHYTHM

- CPR and epinephrine
- Follow ACLS protocol (See ACLS & BLS protocol sheet)



CARDIOVERSION

Planned & **synced** shock delivered on **R wave**

USED FOR

- SVT
- Afib
- Stable vtach with pulse

WHY IS IT SYNCED?
If shock is delivered on T wave can cause **R on T Phenomenon causing vfib** & lead to **CARDIAC ARREST**!

JOULES USED: 50-200

Need consent prior to procedure

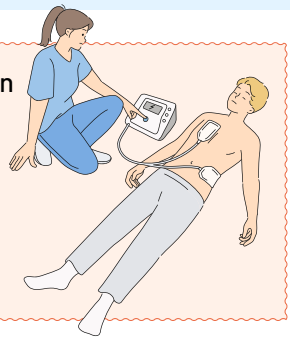
DEFIBRILLATION

Unsynchronized shock given in emergent situation

USED FOR

- Pulseless Vtach
- Vfib

JOULES USED: 200-360

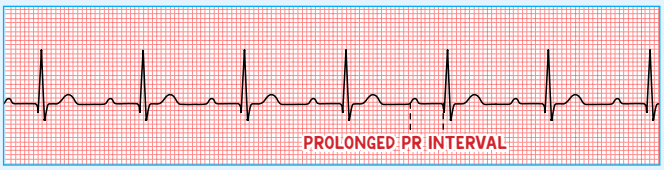


CARDIAC RHYTHMS
HEART BLOCKS

1ST DEGREE HEART BLOCK

"IF THE R IS FAR FROM P, THEN YOU HAVE A FIRST DEGREE"

Abnormally slow conduction through the AV node



RATE:	Normal but can be slower
RHYTHM:	Regular
P-WAVE:	Upright & before every QRS
PR INTERVAL:	Prolonged (>0.20)
QRS:	Normal

CAUSES: MAY BE NORMAL FOR SOME PATIENTS!
- →Old age
- →CAD
- →Electrolyte imbalance
- →Medications that slow AV conduction (Beta blockers & calcium channel blockers)

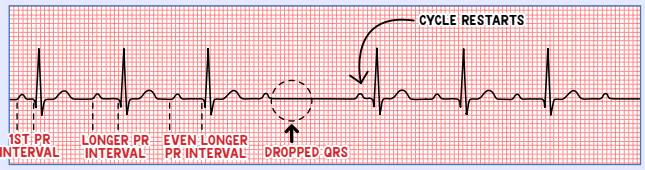
SYMPTOMS:
- →Usually **asymptomatic**

TREATMENT:
- →Usually requires no treatment
- →Monitor to ensure doesn't progress to more serious HB

2ND DEGREE TYPE I AKA WENCKEBACH

"LONGER, LONGER, LONGER, DROP– NOW YOU HAVE A WENCKEBACH!"

PR intervals progressively lengthening until QRS complex is dropped completely



RATE:	Normal
RHYTHM:	Regularly irregular
P-WAVE:	Normal
PR INTERVAL:	Gradually prolonging
QRS:	Drops in repeating pattern

CAUSES:
- →Rheumatic fever
- →↑ vagal tone
- →Myocardial infarction
- →Medications (Beta blockers & calcium channel blockers)

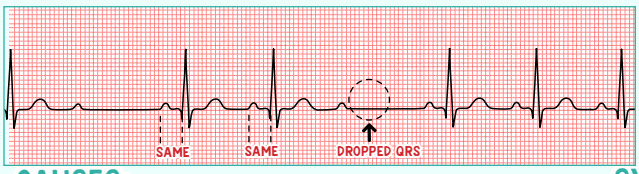
SYMPTOMS: May be ASYMPTOMATIC
- →Dizziness
- →SOB
- →Weakness
- →AMS
- →Chest pain

TREATMENT: If symptomatic NOTIFY MD
- →Check VS
- →Oxygen
- →EKG
- →Labs

2ND DEGREE TYPE II AKA MOBITZ II

"IF SOME P'S DON'T GET THROUGH–THEN YOU HAVE A MOBITZ II!"

P waves stay consistent (not progressively lengthening) & QRS is randomly dropped



More likely to progress to 3RD DEGREE HEART BLOCK

RATE:	Normal
RHYTHM:	Irregular
P-WAVE:	Normal ("marching" along)
PR INTERVAL:	Constant (does not get gradually longer)
QRS:	Randomly drops

CAUSES:
- →CAD
- →Cardiomyopathy
- →Myocardial infarction
- →Medications (Beta blockers & calcium channel blockers)

SYMPTOMS:
- →Dizziness
- →Weakness
- →Syncope

TREATMENT:

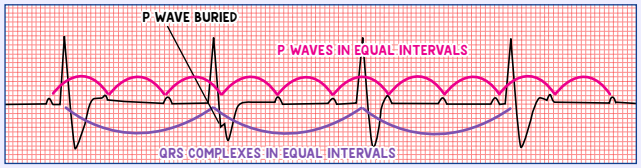
ASYMPTOMATIC
- →Consult cardio
- →Review meds

SYMPTOMATIC → NOTIFY MD
- →Temporary pacing
- →Permanent pacemaker

3RD DEGREE HEART BLOCK

"IF P'S AND Q'S DON'T AGREE–THEN YOU HAVE A THIRD DEGREE"

Complete loss of communication between atria & ventricles ("marching to beat of their own drum")



MEDICAL EMERGENCY
Heart can't pump blood efficiently

RATE:	Usually <60 bpm
RHYTHM:	Regular
P-WAVE:	Independent from QRS
PR INTERVAL:	Variable
QRS:	Independent from P waves

CAUSES:
- →Myocardial infarction
- →Digoxin toxicity
- →Cardiomyopathy
- →CAD

SYMPTOMS: FROM ↓ CARDIAC OUTPUT
- →Hypotension
- →Chest pain
- →Weakness
- →Pale
- →Clammy
- →Weak pulse

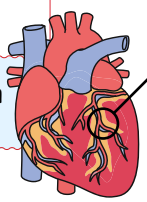
TREATMENT: NOTIFY MD
- →Atropine
- →Temporary pacing
- →Permanent pacemaker

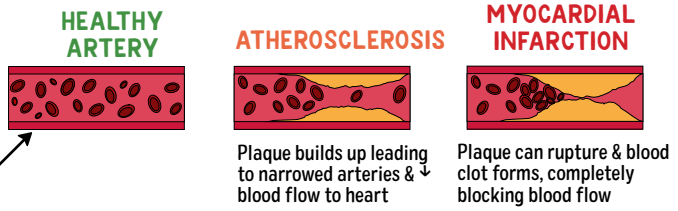
CORONARY ARTERY DISEASE

WHAT IS IT?

Narrowing of the coronary arteries due to atherosclerosis

ATHEROSCLEROSIS
Plaque build up in arteries from cholesterol deposits





RISK FACTORS

MODIFIABLE (CAN BE CHANGED)
- Smoking & alcohol use
- Overweight/Obesity
- Diabetes
- High cholesterol
- Stress
- Sedentary lifestyle

NON-MODIFIABLE (CANNOT BE CHANGED)
- Family history
- Aging
- Race
- Gender

DIAGNOSTICS

- EKG
  - **ST DEPRESSION** Indicates ischemia
  - **ST ELEVATION** Indicates injury
- STRESS TEST
- CARDIAC CATHETERIZATION (check arteries)
- LABS
  - **HDL**: GOOD cholesterol; THINK H FOR HAPPY; WANT HAPPY LEVELS HIGH; >60 MG/DL
  - **LDL**: BAD cholesterol; THINK L FOR LOUSY; WANT LOUSY LEVELS LOW; <100 MG/DL

OTHER VALUES
TRIGLYCERIDES: <150 mg/dL TOTAL CHOL: <200 mg/dL

SYMPTOMS

USUALLY ASYMPTOMATIC!
- **Chest pain that goes away with rest**
- Diaphoresis
- Shortness of breath
- Heartburn
- Nausea/ vomiting
- Fatigue

PATIENT EDUCATION

GOAL: Patient education to **prevent progression**

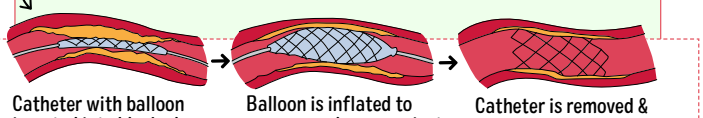
- Smoking cessation
- Moderate exercise 3-4 times/week
- Stress management
- Weight management
- Monitor heart rate & blood pressure

DIET
- ↓ sodium ↓ saturated fat
- ↓ alcohol
- ↑ fiber ↑ fruits & vegetables

TREATMENT

MEDICATIONS
- **Antiplatelets:** prevent clots from forming
  - ASPIRIN
- **Antilipidemics:** lower cholesterol levels
  - -STATIN
- **Nitrates:** for episodes of angina (dilates vessels)
  - NITROGLYCERIN
- **Antihypertensives**
  - Beta blockers
  - Calcium channel blockers
  - ACE inhibitors
  - ARBs (if cannot tolerate ACE)

PROCEDURES
- **Atherectomy:** removal of plaque from artery
- **Percutaneous Coronary Intervention (PCI):** unblocks arteries to restore blood flow with balloon and possible stent placement



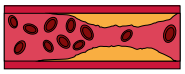
ANGINA PECTORIS

WHAT IS IT?

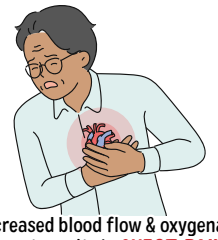
Chest pain caused by reduced myocardial blood flow and oxygenation

Classic symptom of **CORONARY ARTERY DISEASE**

MOST COMMON CAUSE: **ATHEROSCLEROSIS**



Plaque builds up leading to narrowed arteries & ↓ blood flow to heart



Decreased blood flow & oxygenation to heart results in **CHEST PAIN**

TYPES OF ANGINA

STABLE	UNSTABLE	PRINZMETAL/ VARIANT	MICROVASCULAR
▸ Occurs during **physical exertion** ▸ Predictable ▸ Relieved with nitrates & rest	▸ Occurs at rest & **more frequently** ▸ Usually not relieved with nitrates & rest **MEDICAL EMERGENCY**	▸ Caused by **coronary vasospasm** ▸ Occurs at rest ▸ Relieved by nitro & calcium channel blockers	▸ Spasms of microvascular arteries ▸ Pain usually lasts >20 min ▸ Can be stable or unstable

COMMON TRIGGERS:

- → Physical exertion (Shoveling snow, strenuous exercise)
- → Extreme cold (causes vasoconstriction)
- → Extreme heat (can lead to heat exhaustion)
- → Stress (increases myocardial demand)
- → Eating a large meal (increases O2 demand for digestion)
- → Smoking

SYMPTOMS

CHEST PAIN

- ★ Feeling tight/ dull/ heavy
- ★ May radiate to arms, neck, jaw, or back

- → Shortness of breath
- → Weakness & fatigue
- → Dizziness
- → Pallor
- → Diaphoresis

TREATMENT

MEDICATIONS

- → **Antiplatelets:** prevent clots from forming
- → **Calcium Channel Blockers:** relax blood vessels
- → **Beta blockers:** reduces O2 demand of heart
- → **Nitrates:** for episodes of angina (dilates vessels)

ADMINISTERING NITROGLYCERIN

- ▸ Administered sublingually every 5 minutes up to 3 doses max
- ▸ Do not take if Sildenafil (Viagra) taken within 24 hrs
- ▸ Call 911 if pain not relieved 5 minutes after 1st dose

PROCEDURES

- → **Percutaneous Coronary Intervention (PCI):** catheter inserted into arteries with possible stent placement to restore blood flow
- → **Coronary Artery Bypass Surgery (CABG):** vein or artery used to bypass a blocked or narrowed heart artery

NURSING INTERVENTIONS

- → Vital signs & EKG
- → Administer oxygen
- → Nitroglycerin
- → Semi-fowler's position
- → Maintain calm & quiet environment
- → Encourage rest
- → Monitor pain

EDUCATION: LIFESTYLE MODIFICATIONS

- → Smoking cessation
- → Moderate exercise 3-4 times/week
- → Stress management
- → Weight management
- → Monitor heart rate & blood pressure

DIET

- → ↓ sodium ↓ saturated fat
- → ↓ alcohol
- → ↑ fiber ↑ fruits & vegetables

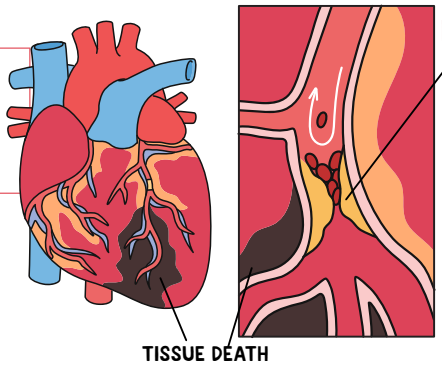
MYOCARDIAL INFARCTION

WHAT IS IT?

Myocardial tissue death due to **blockage of blood flow** in one or more coronary arteries

MEDICAL EMERGENCY

IF NOT TREATED PROMPTLY CAN LEAD TO CARDIAC ARREST



BLOCKAGE OF BLOOD FLOW in coronary artery

↓

heart muscle cells don't get enough O2 rich blood

↓

> 30 minutes of blockage causes **PERMANENT DAMAGE**

CAUSES

O2 SUPPLY CAN'T MEET O2 DEMAND

- **ATHEROSCLEROSIS:** plaque ruptures & becomes a blood clot, blocking blood flow
- **ARTERIOSCLEROSIS:** arterial walls thicken and become stiff, blocking blood flow
- **THROMBUS:** blood clot that obstructs vessel
- **CORONARY ARTERY SPASM:** temporary tightening of the vessel blocks blood flow
- **DECREASED OXYGEN SUPPLY:** due to blood loss, anemia, or hypotension

DIAGNOSTICS

- **PATIENT HISTORY** (check for hx of heart disease)
- **CHECK TROPONIN LEVEL** NORMAL < 0.04
- **ECHOCARDIOGRAM**
- **STRESS TEST**
- **CARDIAC CATH**
- **EKG**

NSTEMI

Indicates **LOW** O2

STEMI

Indicates **NO** O2

SYMPTOMS

SUDDEN, CRUSHING CHEST PAIN

May radiate to jaw, arm, or shoulder

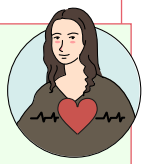
- Shortness of breath
- Indigestion
- Tachycardia
- Diaphoresis
- Pallor

WOMEN MAY EXPERIENCE DIFFERENT SYMPTOMS:

- Extreme fatigue
- Nausea
- Shoulder or neck pain

TREATMENT

1 IMMEDIATE



- **M ORPHINE:** ↓ pain ↓ O2 demand of heart
- **O XYGEN:** ↑ O2 to heart
- **N ITRATES:** dilate arteries to ↑ blood flow
- **A SPIRIN:** prevents blood from clotting

2 NEXT (INTERVENTIONS/ PROCEDURES)

MEDICATION

- **Thrombolytics (Alteplase):** dissolve clot

PROCEDURES

- **PCI:** balloon with possible stent to restore blood flow
- **CABG:** bypass blockage to restore blood flow

3 STABILIZATION & PREVENTION

- **Heparin IV:** prevent clot formation
- Beta blockers
- ACE/ ARB
- Calcium channel blockers
- Statin
- Antiplatelets

NURSING INTERVENTIONS

- Strict bedrest
- Supplemental O2 as ordered

MONITOR

- Vital signs & EKG
- Lung sounds
- Surgical site
- Signs of bleeding
- Labs (especially cardiac enzymes)
- Chest pain

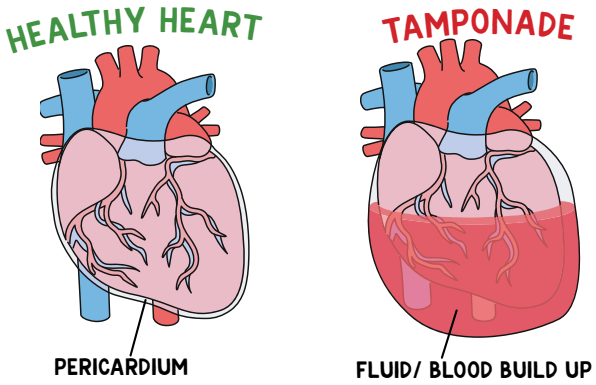
CARDIAC TAMPONADE

WHAT IS IT?

Increased pressure on the heart due to accumulation of fluid in the **pericardial space**

MEDICAL EMERGENCY

Makes it difficult for the heart to pump efficiently causing ↓ CARDIAC OUTPUT



CAUSES

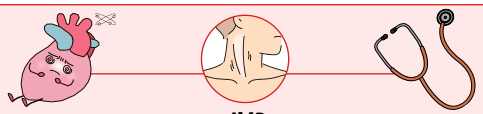
- Pericarditis (infection of the pericardial sac)
- Pericardial Effusion (slow fluid build up)
- Cardiac surgery/ trauma
- Recent MI (inflammation of cardiac tissue)
- Cancer

DIAGNOSTICS

- **CHEST X-RAY:** will show cardiomegaly
- **ECHOCARDIOGRAM:** will show fluid around heart
- **EKG:** may show QRS height variability

SYMPTOMS

CLASSIC SIGN: **BECK'S TRIAD**



HYPOTENSION (from ↓ cardiac output)

JVD (from fluid backing up)

MUFFLED HEART SOUNDS (from fluid around heart)

- Pulsus Paradoxus — Drop of systolic BP >10 points during inspiration
- Dypnea
- Fatigue
- Chest pain or discomfort
- Tachycardia & tachypnea

TREATMENT

★ **PERICARDIOCENTESIS:** drain fluid from around heart

- **Treat underlying cause** (such as antibiotics for pericarditis)

HEMODYNAMIC SUPPORT

- **Fluids** (give carefully & monitor for fluid overload)
- **Volume expanders**
- **Vasopressors**
- **Dobutamine:** ↑ contractility

NURSING INTERVENTIONS

- Administer oxygen
- Bed rest
- Keep HOB elevated
- Educate patient signs of pericardial effusion

MONITOR

- Continuous vital signs & EKG
- Lung sounds
- Labs

PERICARDIAL EFFUSION

Slow fluid build up in pericardial space

If not treated can result in **TAMPONADE**

SYMPTOMS

- Chest pain
- Shortness of breath
- Difficulty breathing while flat

GOAL:
Catch symptoms **early** to prevent progression to tamponade

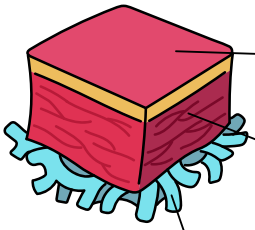
CARDIOMYOPATHY

WHAT IS IT?

Group of diseases that cause dysfunction in the **myocardium** layer of the heart

MYOCARDIUM
Middle layer of the heart responsible for **contractility**

Affects **pumping mechanism** which leads to ↓ **CARDIAC OUTPUT**

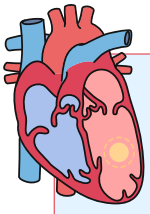


EPICARDIUM

MYOCARDIUM
Middle muscular layer of the heart (thickest layer)
↳ responsible for **contractility**

ENDOCARDIUM

TYPES OF CARDIOMYOPATHY



MOST COMMON

DILATED

Chambers **dilate** & muscle walls become **thin & weak**

Leads to **SYSTOLIC PUMP FAILURE**

CAUSES

- Coronary artery disease
- Alcoholism
- Toxin exposure
- Certain viral infections (can lead to myocarditis)

SYMPTOMS

- Dyspnea
- Orthopnea
- Activity intolerance
- Lower limb edema

+ ALL classic heart failure signs & symptoms

DIAGNOSTICS

X-ray will show enlarged heart

TREATMENT

- **Diuretics:** reduce fluid overload
- **Digoxin:** improve contractility
- **Beta blockers:** ↓ workload of heart
- **ACE:** ↓ afterload & prevent remodeling
- Calcium channel blockers
- Rest periods & stress reduction

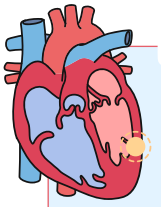
HEART FAILURE

The body thinks blood pressure is low due to dilated ventricles

↓

Activates the **RAAS SYSTEM** to hold onto fluid

Will show signs of **RIGHT** & **LEFT** sided heart failure



MOST DEADLY

HYPERTROPHIC

Heart walls become **thick, stiff & non-compliant**

Can obstruct aortic valve & cause **SUDDEN DEATH**

CAUSES

- **Genetics** (usually diagnosed in childhood)

SYMPTOMS

USUALLY ASYMPTOMATIC!

- Dyspnea
- Syncope
- Chest pain

DIAGNOSTICS

Echo will show **septal wall thickening**

TREATMENT

- **Myectomy:** remove extra tissue

MEDICATIONS

- **Beta blockers:** ↓ HR to ↑ diastolic filling time
- **Calcium channel blockers**

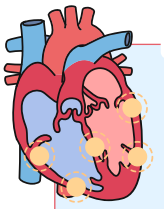
NEVER GIVE THE 3 D'S

- ✕ Digoxin
- ✕ Dilators (nitro)
- ✕ Diuretics

Will **WORSEN** obstruction & symptoms

AVOID STRENUOUS ACTIVITY

- Intense exercise
- Sudden position changes
- Bearing down (valsalva maneuver)



RESTRICTIVE

Heart muscle becomes **stiff & hard** like a rock

Stiff ventricles cause **REFILLING ISSUES**

CAUSES

- Genetics (amyloidosis, sarcoidosis)
- Radiation exposure

SYMPTOMS

Similar to **DILATED CARDIOMYOPATHY**

- Dyspnea
- Orthopnea
- Activity intolerance
- Lower limb edema

DIAGNOSTICS

Normal echo & x-ray

TREATMENT

TREAT UNDERLYING CAUSE!

- Heart transplant
- Decrease radiation exposure
- Diuretics: reduce fluid overload

↳ The heart muscle is **too hard & stiff** for other medications to have a positive effect

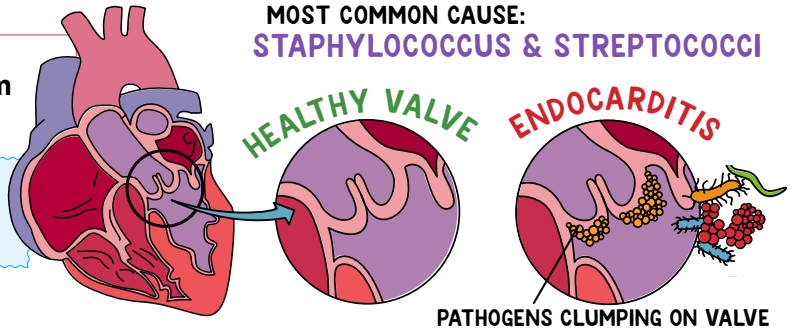
INFECTIVE ENDOCARDITIS

WHAT IS IT?

Inflammation of the **endocardium** layer of the heart

ENDOCARDIUM

Innermost layer that lines the heart chambers & valves



CAUSED BY BACTERIA OR FUNGI

Pathogens enter blood stream through opening & travel to heart

↓

Attach to damaged or weakened heart tissue

↓

Pathogens begin to grow & eventually cause damage

Bacteria attach to valves causing damage which leads to **impaired pumping action** of the heart causing:

↓ CARDIAC OUTPUT

Bacteria form clumps called "vegetations" which platelets build up over time and can form into a **BLOOD CLOT**

RISK FACTORS

- Age >60
- Artificial heart valve or devices
- Damaged heart valves
- Poor oral hygiene
- Congenital heart disease
- Immunosuppressed
- IV drug use
- Untreated strep throat (leads to rheumatic fever)

SYMPTOMS

CLASSIC SIGNS:

- ★ **Osler's nodes** (painful lesions on hands)
- ★ **Janesway lesions** (nontender lesions on palms & feet)
- ★ **Splinter hemorrhages** (clots stuck under nails)
- ★ **Roth spots** (tiny hemorrhages in eye)

- Fever & chills
- New/ changed heart murmur
- Crackles & dyspnea
- Chest pain on inspiration
- Splenomegaly
- Edema and/ or ascites
- Petechiae

DIAGNOSTICS

- **BLOOD CULTURES:** assess for infective agent
- ★ **TRANSESOPHOGEAL ECHO:** assess for vegetation
- **CBC:** will have ↑ WBC

TREATMENT

SURGERY

Remove dead & infected tissue

ANTIBIOTIC THERAPY

Will require IV antibiotics up to 4 weeks

WILL GO HOME WITH PICC LINE

NURSING INTERVENTIONS

- Supplemental oxygen
- DVT prevention
- Antipyretics for fever

MONITOR

- Vital signs (especially temperature)
- Heart rhythm
- Signs of heart failure
- Embolic episodes

WATCH FOR SIGNS OF:

- Pulmonary embolism
- Stroke
- Flank pain (renal)
- Abdominal pain (spleen)

EDUCATION

- ★ Monitor for signs of infection
- ★ Always use aseptic technique
- ★ Do NOT stop antibiotics (must fully finish ABX course)

DENTAL CARE

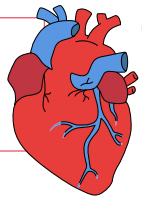
Educate patient about importance of **good oral hygiene** & to notify dentist before any **invasive procedures**

HEART FAILURE

WHAT IS IT?

Dysfunction of the heart affecting it's ability to **fill or pump blood effectively**

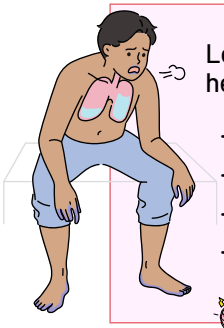
Leads to ↓ **CARDIAC OUTPUT**



CAUSES: Anything that damages or weakens the heart

- Cardiomyopathy
- Coronary artery disease
- Myocardial infarction
- Hypertension
- Endocarditis
- Congenital heart disease
- Arrhythmias
- Alcohol or drug use

LEFT-SIDED



Left side of heart can't pump blood out of heart so blood backs up into the **LUNGS**

- → Dyspnea & SOB
- → Crackles
- → Fatigue
- → Pink, frothy sputum

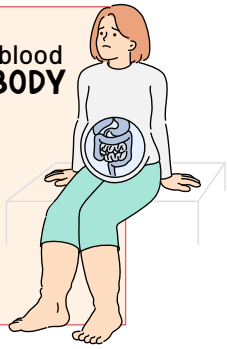
REMEMBER L FOR LUNGS

RIGHT-SIDED

Right side of heart can't pump recieved blood to the lungs so blood backs up into the **BODY**

- → Peripheral edema
- → Ascites
- → JVD
- → Hepatomegaly

REMEMBER R FOR REST OF BODY



DIAGNOSTICS

★ → **BNP BLOOD TEST:** biomarker released by ventricles from excessive pressure & when they become stretched

- → **STRESS TEST**
- → **CHEST X-RAY** (may show infiltrates & cardiomegaly)
- → **CARDIAC CATH**
- → **ECHOCARDIOGRAM** Measures ejection fraction

<100: Normal
300+: Mild heart failure
600+: Moderate heart failure
900+: Severe heart failure

EJECTION FRACTION

Amount of blood being ejected from left ventricle in one pump

55–70% NORMAL | <40% BAD

NURSING INTERVENTIONS

- → Supplemental 02
- → High fowler's position
- → Keep legs elevated
- → Fall risk precautions (due to orthostatic hypotension & fluid status)

MONITOR

- → Daily weights
- → Strict I &O
- → VS & heart rhythm
- → Lung sounds

DIET

- → ↓ Sodium (<2g/ day)
- → ↓ Fat
- → Fluid restriction

AVOID

- ✕ OTC drugs (contain sodium)
- ✕ Fried & processed foods
- ✕ Canned vegetables & beans

HEART FAILURE MEDS

1 ACE INHIBITORS/ ARB

Vasodilate to lower blood pressure (only affect BP, **not HR**)

ACE INHIBITOR –PRIL **Ex:** Lisinopril
→ **SIDE EFFECTS:** Dry, nagging cough

ARB (Angiotensin II Receptor Blocker) –SARTAN **Ex:** Losartan
→ **SIDE EFFECTS:** Increases potassium levels

ARB only used if can't tolerate ACE INHIBITOR

2 BETA BLOCKER

Decreases workload of heart

–LOL **Ex:** Metoprolol
→ ALWAYS CHECK BP & HR PRIOR TO GIVING

SIDE EFFECTS
- Masks hypoglycemia
- Bronchospasm
- Bradycardia

3 DIGOXIN

Positive inotropic that increases contractility

→ MAKES HEART PUMP STRONG & SLOW
Check **apical pulse** before administering

Monitor for DIGOXIN TOXICITY
Hypokalemia increases risk so want to **MONITOR K+ LEVELS**

4 CALCIUM CHANNEL BLOCKERS

Relaxes vessels to lower blood pressure

EXAMPLES:
- Cardizem
- Nifedipine
- Verapamil

DO NOT GIVE IF:
- HR <60
- SBP <100 or large drop in BP

5 VASODILATORS

Dilates vessels to decrease preload & afterload

EXAMPLES:
- Nitroglycerin
- Hydralazine
- Isosorbide

DO NOT GIVE IF:
- Sildenafil taken within 24 hours
- SBP <100

6 DIURETICS

Drains excess fluid from body

Monitor K+ levels
NORMAL: 3.5–5

POTASSIUM WASTING –IDE **Ex:** Furosemide & Torsemide
→ Used in **worsening** or **acute** heart failure

POTASSIUM SPARING → Spironolactone

Always check BP before giving diuretics!

HYPERTENSION

WHAT IS IT?

Condition where the pressure in the blood vessels is consistently higher than normal

HYPER (High) **TENSION** (Pressure)

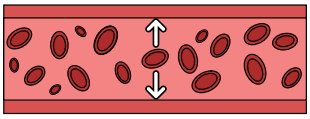
MARKED BY >2 EVENTS OF BP >130/80

DUE TO:

↑ PERIPHERAL RESISTENCE AND/OR ↑ CARDIAC OUTPUT

Vasoconstriction= ↑ resistance
Vasodilation= ↓ resistance

↑ blood volume output
= ↑ blood pressure



120 / 80

STAGE	SYSTOLIC		DIASTOLIC
NORMAL	<120	AND	<80
ELEVATED	120–129	AND	<80
STAGE 1	130–139	OR	80–89
STAGE 2	140 & ABOVE	OR	90 & ABOVE
HYPERTENSIVE CRISIS	>180	AND/OR	>120

FACTORS AFFECTING BP READINGS

CUFF SIZE

Too **BIG**= false **low** blood pressure

Too **SMALL**= false **high** blood pressure

ARM POSITION

Above heart= false **low** blood pressure

Dangling= false **high** blood pressure

WHITECOAT SYNDROME

Temporarily high BP in doctor's office due to anxiety (allow time to relax & recheck)

CAUSES/ RISK FACTORS

PRIMARY

Unknown cause so look at **risk factors**

NON-MODIFIABLE

- →Age
- →Race
- →Family History

HIGHEST RISK

- African Americans
- Age >65
- + Family history

MODIFIABLE

- → Obesity
- → Alcohol & smoking
- → Sedentary
- → Stress
- → ↑ cholesterol
- → ↑ sodium intake

SECONDARY

Direct cause or pre-existing condition

- →Diabetes
- →Kidney disease
- →Pregnancy
- →Thyroid imbalance
- →Pheochromocytoma
- →Cushing's
- →Atherosclerosis
- →Sleep apnea

SYMPTOMS

OFTEN ASYMPTOMATIC!

Known as the **"SILENT KILLER"**

- → Headache
- → Blurred vision
- → Dizziness
- → Chest pain
- → Shortness of breath

UNMANAGED HTN CAN LEAD TO:

- Stroke
- Myocardial infarction
- Renal failure
- Heart failure

TREATMENT

MEDICATIONS

- → ACE/ ARBs
- → Beta blockers
- → Calcium channel blockers
- → Diuretics

LIFESTYLE MODIFICATIONS

- → Weight loss
- → Stress management
- → Moderate exercise 3-4 times/ week
- → Smoking cessation

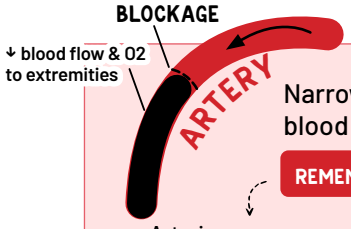
DIET EDUCATION

DASH DIET (**D**ietary **A**pproaches to **S**top **H**ypertension)

- ↑ fruits & vegetables
- low fat dairy
- ↓ sodium & saturated + trans fats
- ↓ alcohol & caffeine intake
- Avoid processed foods (↑ saturated fat)
- Avoid canned foods (contain ↑ sodium)

PAD vs PVD

(PERIPHERAL ARTERY DISEASE) (PERIPHERAL VASCULAR DISEASE)



PAD

Narrowed arteries cause ↓ blood flow to extremities

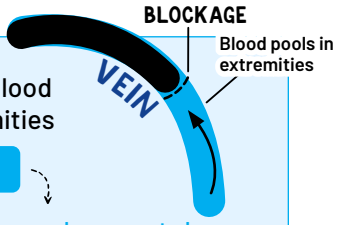
REMEMBER A FOR AWAY

Arteries carry oxygenated blood away from heart to the rest of the body

PVD

Narrowed veins cause ↓ blood return & pooling in extremities

REMEMBER V FOR VISIT



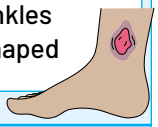
Veins carry deoxygenated blood from the body & tissues to the heart

CAUSES

- Hypertension
- Uncontrolled diabetes
- Smoking
- Hyperlipidemia
- Sedentary lifestyle
- Aging

SYMPTOMS

	PAD	PVD
PULSES	Decreased or absent	Present (may need doppler due to edema)
SKIN	→ Dry & thin → Shiny & missing hair	Thick & tough
COLOR & TEMP	Pale & cool	Brown/ yellow & warm
EDEMA	None (there's no blood flow!)	Present (blood is pooling)
PAIN	Intermittent Claudication — Sharp pain in calf with activity or elevation that goes away with rest	Constant, dull & achy
LESIONS	→ Eschar & necrosis → Ends of toes & tops of feet → Deep "hole-punched" look	→ Red, granulation & drainage → Medial lower legs & ankles → Shallow & irregular shaped



DIAGNOSTICS

PAD

ANKLE-BRACHIAL INDEX: Ankle blood pressure compared to arm blood pressure

Lower ankle pressure indicates ↓ blood flow

PVD

VENOUS ULTRASOUND: Assess for blood flow & any signs of reflux in veins

TREATMENT

PAD

HANG ARTERIES

Dangle legs to promote circulation & help with pain

Elevating legs will make pain **WORSE!**

PVD

ELEVATE VEINS

Elevate legs to help promote blood return to heart

Dangling legs will make edema **WORSE!**

MEDICATION

→ Antiplatelets (Aspirin or Clopidogrel)
→ Statins

PROCEDURES

PAD

→ **Artherectomy:** remove plaque build up in arteries
→ **Peripheral Bypass Graft:** blood flow rerouted around occluded artery

PVD

→ Angioplasty or stent placement
→ **Peripheral Bypass Graft:** blood flow rerouted around occluded vein

EDUCATION

PAD

→ Stop smoking
→ Avoid crossing legs
→ Avoid cold temps (keep feet warm)

PVD

→ Compression stockings
→ Avoid sitting or standing long periods of time
→ Elevate legs when resting