

# Examination Of The Cardiovascular System

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# Cardiovascular Exam

- Includes
  - appropriate history and ROS
  - Vital Signs: Blood pressure; Pulse: rate, rhythm, volume
  - Assessment distal vasculature (legs, feet, carotids) → vascular disease (atherosclerosis) is a systemic illness !
  - Pulmonary Exam (coming soon)
- **4 basic PE components:**
  - **Observation, Palpation, Percussion (omitted in cardiac exam) & Auscultation**

# Thoughts On Gown Management & Appropriately/Respectfully Touching Your Patients

- Several Sources of Tension:
  - Area examined **reasonably exposed** – **yet patient** modesty preserved
  - **Palpate sensitive areas** to perform accurate exam - requires touching **people w/whom** you've **little acquaintance** – awkward, particularly if **opposite gender**
  - **Exam not natural/normal** part of interpersonal **interactions** - as newcomers to medicine, you're particularly aware & hence sensitive → a good thing!

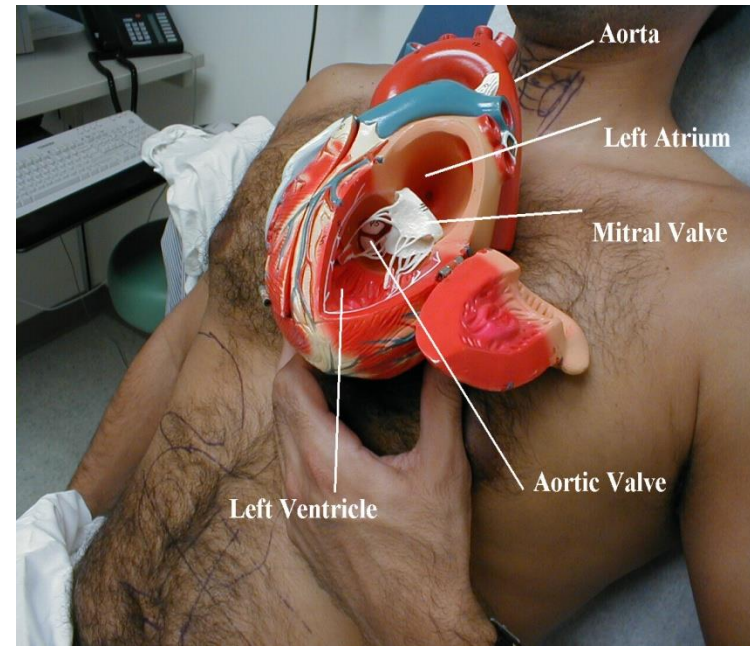
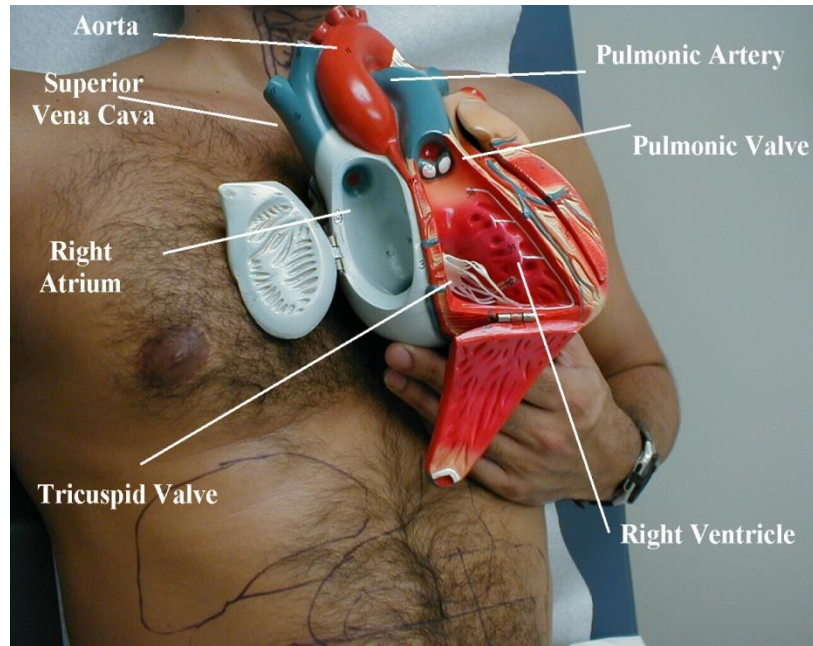
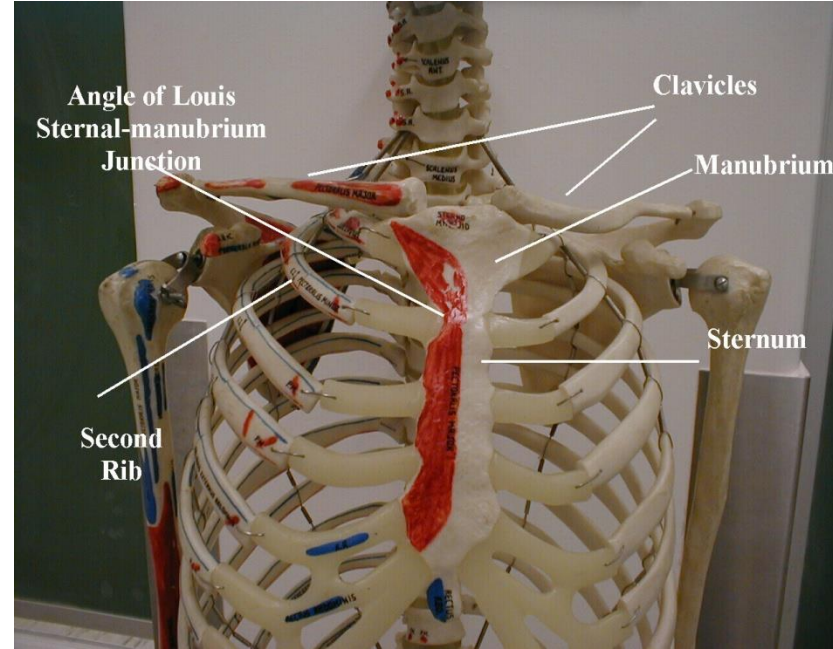
# Keys To Performing a Respectful & Effective Exam

- Explain what you're doing (& why) before doing it → acknowledge “elephant in the room”!
- Expose minimum amount of skin necessary - “artful” use of gown & drapes (males & females)
- Examining heart & lungs of female patients:
  - Ask patient to remove bra prior and/or learn to work around bra
  - Expose side of chest to extent needed
  - Enlist patient's assistance → positioning breasts to enable cardiac exam
- Don't rush, act in a callous fashion, or cause pain
- **PLEASE...** don't examine body parts thru gown:
  - **Poor technique**
  - **You'll miss things**
  - **You'll lose points on scored exams (OSCE, CPX, USMLE)!**

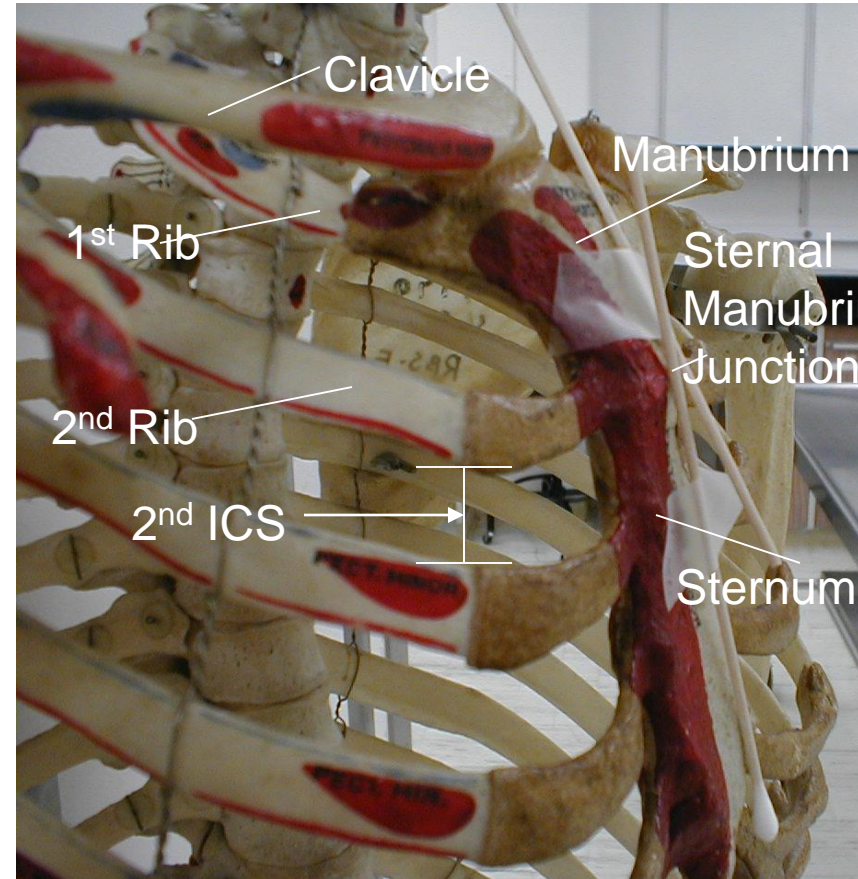
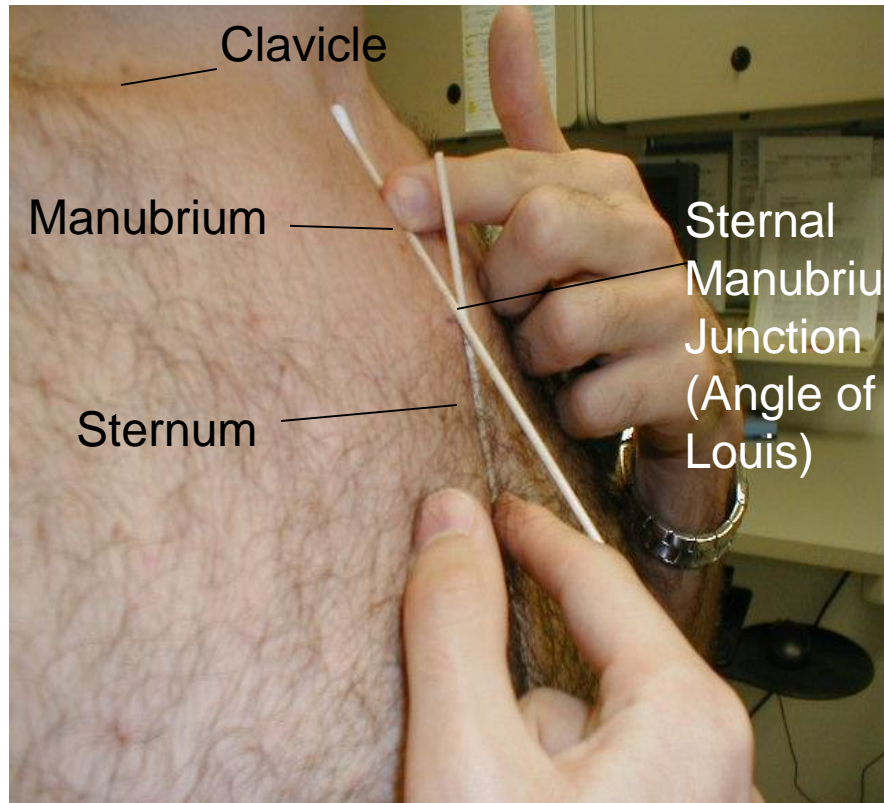
# Observation

- Pay attention to:
  - **Chest** shape
  - Shortness of **breath** (@ rest or **walking**)?
  - **Sitting** upright? Able to **speak**?
  - ? Visible **impulse** on chest wall from vigorously contracting ventricle (**rare**)

# Surface Anatomy

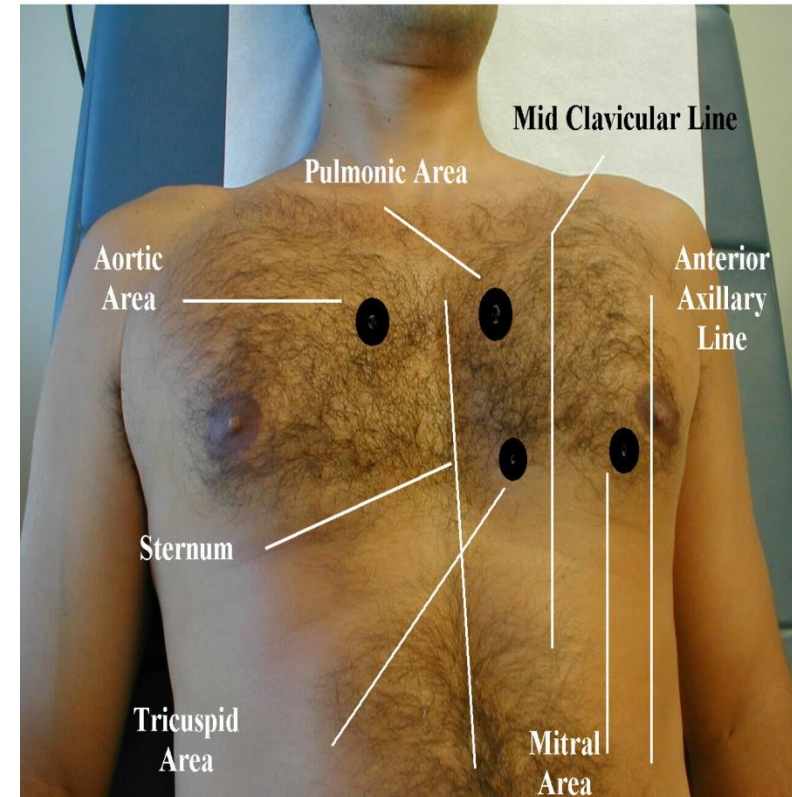
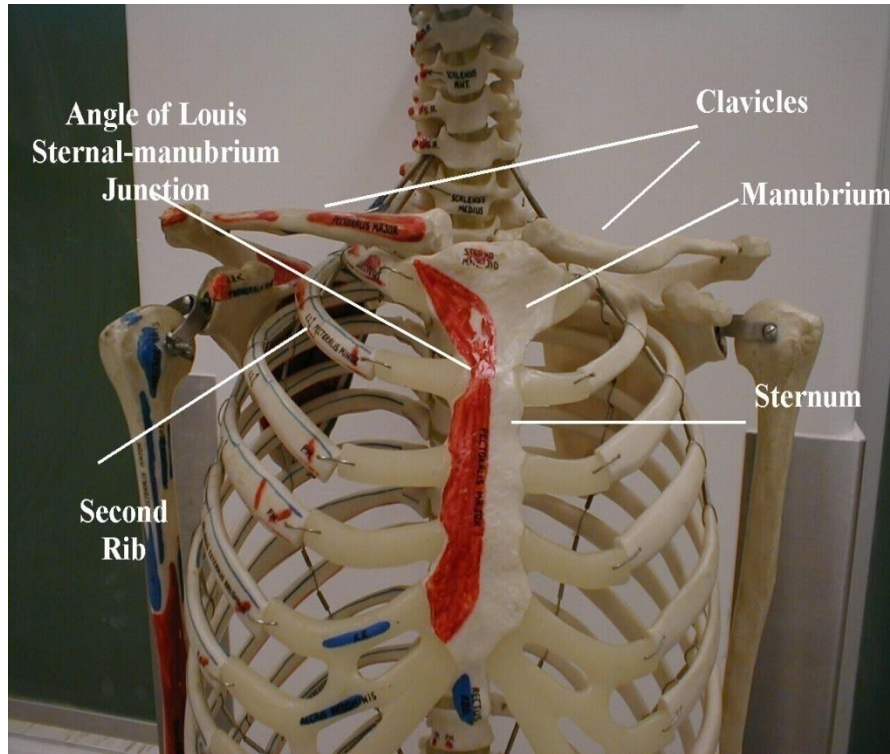


# Finding The Sternal Manubrium Junction (aka Angle of Louis) – Key To Identifying Valve Areas



**Manubrium** slopes in one direction while **Sternum** angles in different direction. Highlighted by q-tips → intersection defines **Sternal Manubrium Junction**

# Valves And Surface Anatomy



- Areas of **auscultation** correlate w/rough **location** of each **valve**
- Where you listen will determine what you hear!

More Anatomy @:

<http://www.blaufuss.org/tutorial/indexTut.html>

PIE Group: [http://pie.med.utoronto.ca/PIE/PIE\\_whatWeDo\\_valves.html](http://pie.med.utoronto.ca/PIE/PIE_whatWeDo_valves.html)



# Palpation - Technique

## Left ventricle

- **Fingers across chest**, under breast (explain 1st)
- Point of Maximal Impulse (PMI) → apex ventricle that pin-points w/finger tip; ~70% of patients - if not palpable, repeat w/patient on L side
- **Size** of LV – increased dimension if PMI shifted to L of mid-clavicular line
- **Vigor** of contraction
- Palpable **thrill** (rare) - associated w/regurgitant or stenotic murmurs (feels like sensation when kink garden hose)



For Male Patients



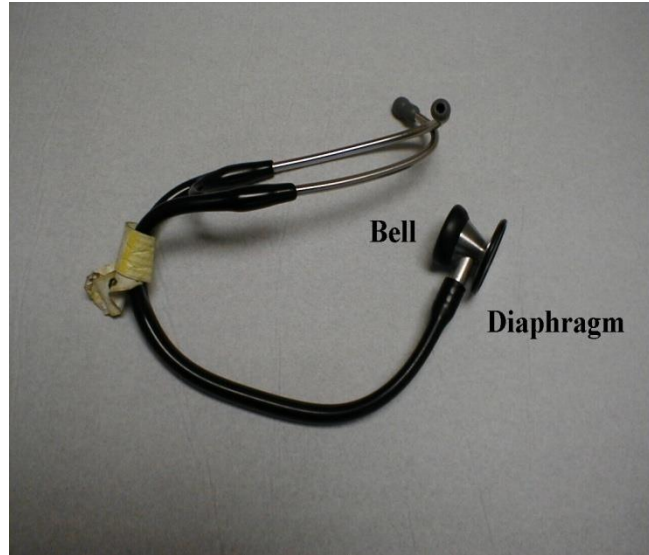
For Female Patients

# Palpation – Technique (cont)

- **Right ventricle:**
  - Vigor of **contractility**
    - **heel of R hand** along sternum
  - Rarely abnormal with RV (pulmonary hypertension)



# Auscultation: Using Your Stethoscope



**They all work - most important part is what goes between the ear pieces!**

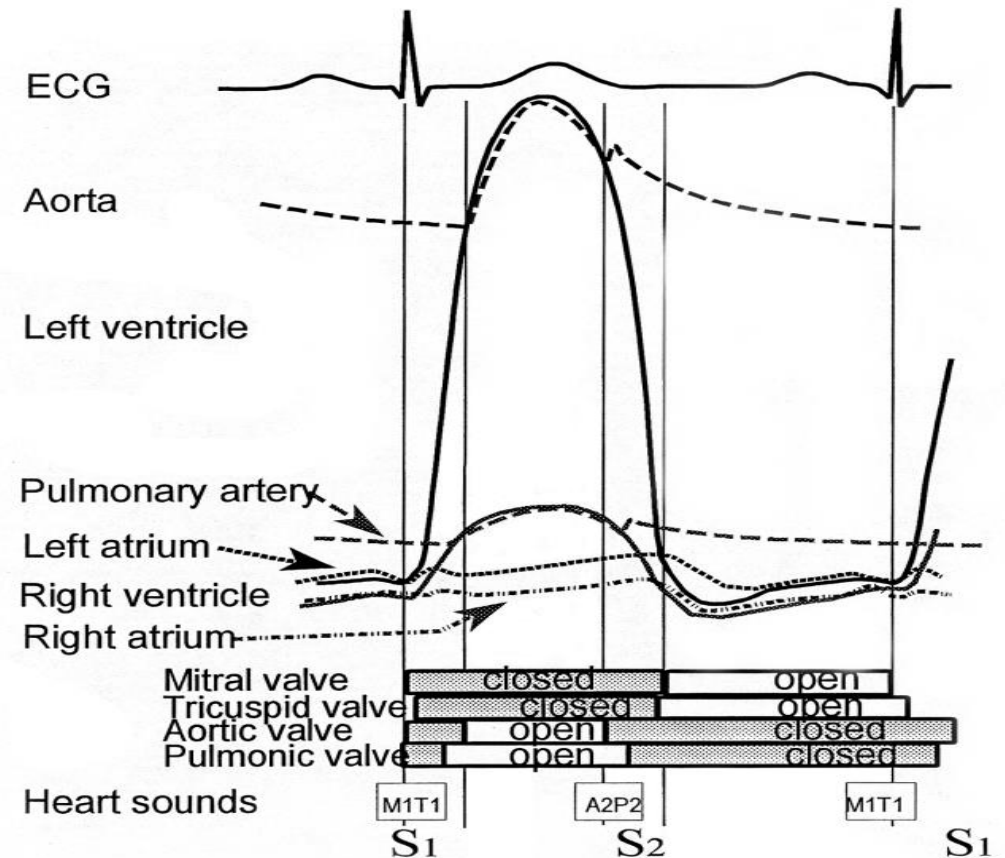


**Diaphragm → Higher pitched sounds**  
**Bell → Lower pitched**



# What Are We Listening For?

- **Normal valve closure** creates **sound**
- **First Heart Sound = S1** → closure of **Mitral, Tricuspid** valves
- **Second Heart Sound = S2** → closure of **Pulmonic, Aortic** valves



**Figure 4:** Cardiac cycle in left and right hearts  
Courtesy Wilbur Lew, M.D.

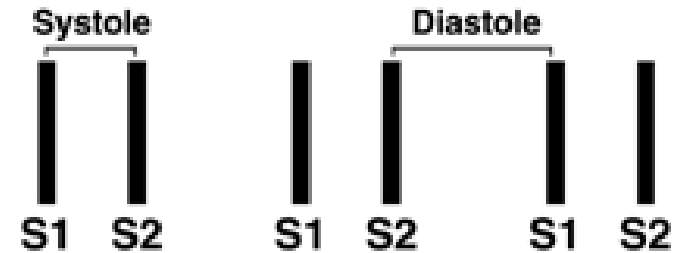
Nice animation linking cardiac events to Wiggers, ECG and Heart Sounds:

[https://library.med.utah.edu/kw/pharm/hyper\\_heart1.html](https://library.med.utah.edu/kw/pharm/hyper_heart1.html)

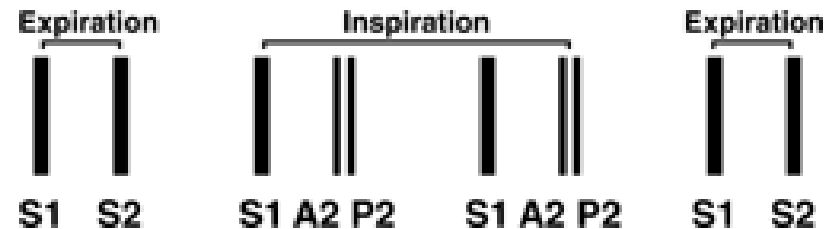
# What Are We Listening For? (cont)

- **Systole** =s time **between S1 & S2**; **Diastole** =s time **between S2 & S1**
- Normally, **S1 & S2 = distinct** sounds
- **Physiologic splitting** =s 2 components of second heart sound (**Aortic & Pulmonic** valve closure) **audible w/inspiration**

## NORMAL CARDIAC CYCLE



## PHYSIOLOGIC SPLITTING OF S2

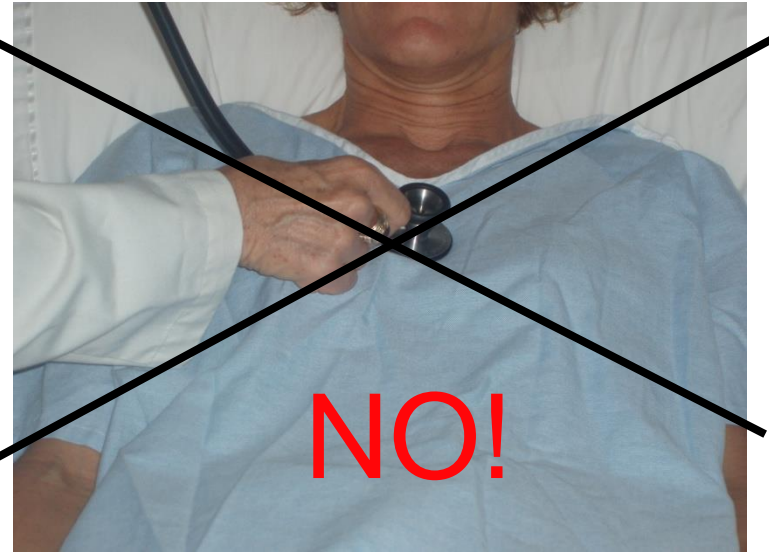
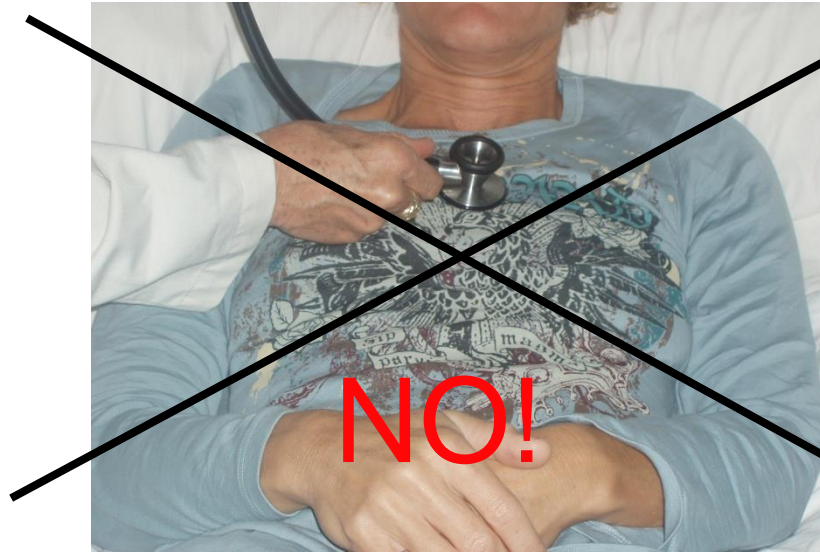


Blaufuss Simulated Physiologic Splitting of S2: <http://www.blaufuss.org/tutorial/indexTut.html#>

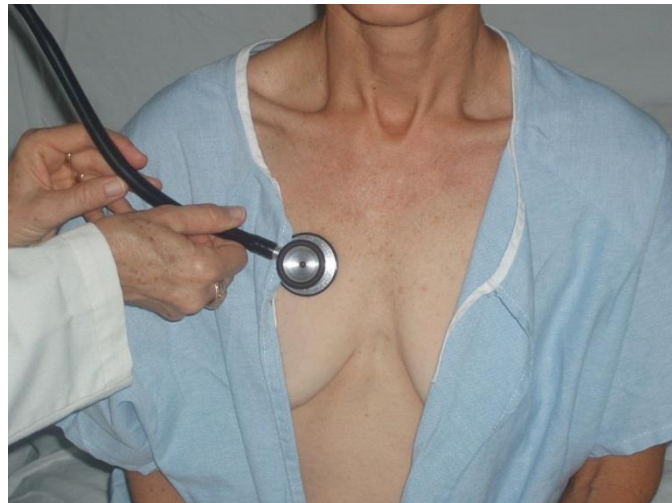
# Auscultation Technique

- Patient **lying @ 30-45** degree incline
- **Chest exposed** (male) or loosely fitted gown (female)
  - need to see area where placing stethoscope
  - stethoscope must contact skin
- Stethoscope w/**diaphragm** (higher pitched sounds) engaged

Remember – Don't Examine Thru Clothing or "Snake"  
Stethoscope Down Shirts/Gowns !



# Exam Options When Listening to Female Patients





# Auscultation Technique (cont)

1. Start over **Aortic area** → **2<sup>nd</sup> Right** Intercostal Space (**ICS**) – Use Angle of Louis as landmark
  2. **Pulmonic** area (**2<sup>nd</sup> L ICS**)
  3. Inch down sternal border → **Tricuspid** area (**4<sup>th</sup> L ICS**)
  4. Inch towards **Mitral** area (**4<sup>th</sup> ICS, mid-clavicular**)
- Listen in ~ **6 places** - precise total doesn't matter – gives you sense of change in sounds as change location

# Auscultation

- In each area, ask yourself:
  - Do I hear **S1**? Do I hear **S2**? Which is **louder** & what are relative **intensities**?
- **Interval between S1 & S2 (systole) is shorter** than between **S2 & S1 (diastole)**
- Can also determine **timing** by simultaneously **feeling pulse** (a **systolic** event)
- **Listen** for **physiologic splitting** of 2nd heart sound w/inspiration

# Murmurs

- **Murmurs:** Sound created by **turbulent flow** across valves:
  - **Leakage (regurgitation)** when valve closed
  - **Obstruction (stenosis)** to flow when normally open
- **Systolic Murmurs:**
  - **Aortic stenosis, Mitral regurgitation**  
(Pulmonary stenosis, Tricuspid regurgitation)
- **Diastolic Murmurs:**
  - **Aortic regurgitation, Mitral stenosis**  
(Pulmonary regurgitation, Tricuspid stenosis)

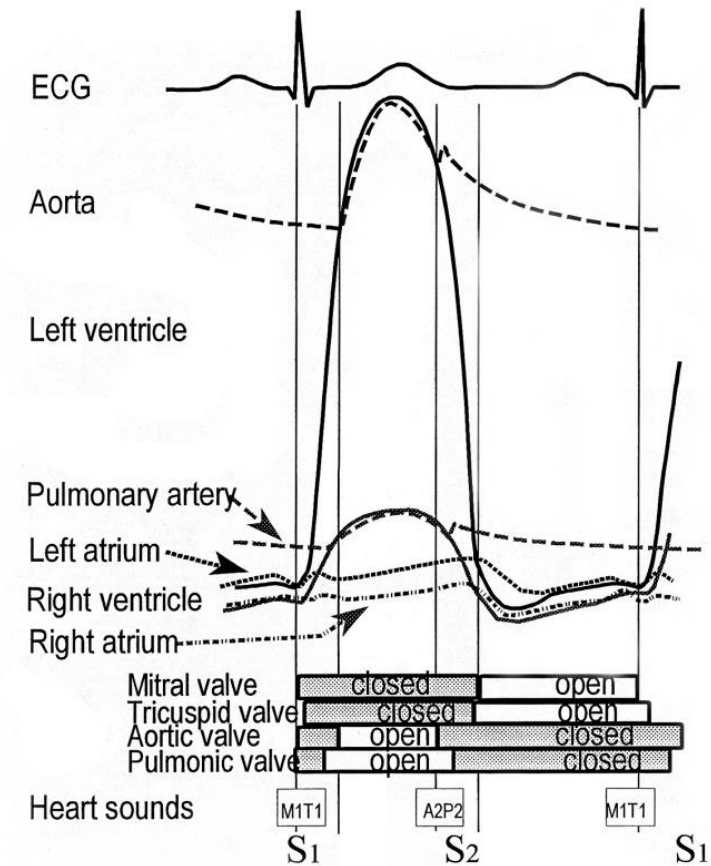


Figure 4: Cardiac cycle in left and right hearts

# Murmurs (cont)

- Characterized by: **position** in cycle, **quality**, **intensity**, **location**, **radiation**; can try to draw it's shape:



- **Intensity Scale:**  
1 –barely audible 2- readily audible 3- even louder 4- loud + thrill 5- audible with only part of diaphragm on chest 6 – audible w/out stethoscope
- **intensity doesn't necessarily correlate w/severity**
- Some **murmurs** best appreciated in certain **positions**:  
**Mitral:** patient on **L side**; **Aortic:** **sitting** up and leaning **forward**
- Example – **Mitral Regurgitation:** Holosystolic, loudest in mitral area, radiates towards axilla.

Blaufuss Medical: <http://www.blaufuss.org/tutorial/indexTut.html>

UCLA Heart Sound Simulator: <http://www.med.ucla.edu/wilkes/intro.html>

# Extra Heart Sounds – S3 & S4

- **Ventricular** sounds, occur during diastole
  - normal in young patient (~ < 30 yo)
  - usually LV, rarely RV
- **S3 → follows S2**
  - caused by blood from LA colliding w/“left over” blood in LV
  - associated w/heart failure.

EXTRA HEART SOUNDS - S3



- **S4 → precedes S1**
  - caused during atrial systole
  - when blood squeezed into non-compliant LV
  - associated w/HTN

EXTRA HEART SOUNDS - S4



# Extra Heart Sound (cont)

- **S3 & S4** are **soft, low pitched**
- Best heard w/**bell**, laid **over LV**, w/patient lying on **L side** (brings apex of heart closer to chest wall)
- Abnormal beyond age ~30
- When present, **S3 or S4** are referred to as “**gallops**”

University of Washington, Simulated **S3 & S4**

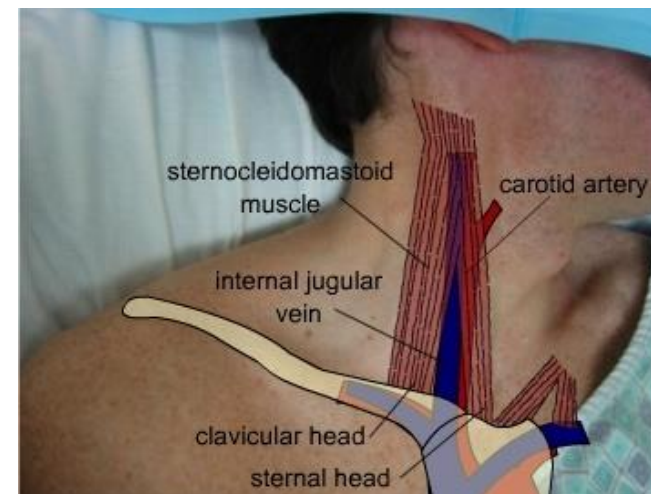
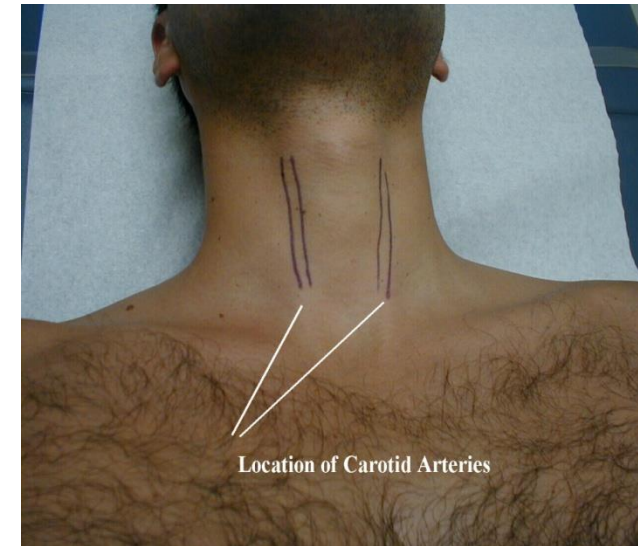
<http://depts.washington.edu/phsdx/heart/demo.html>

# Auscultation – An Ordered Approach

- Do I hear **S1**? Do I hear **S2**?
  - Listen in **each major valvular** area – think about which sound should be loudest in each location (S1 loudest region of TV & MV, S2 loudest AV & PV)
- Do I hear **physiologic splitting** of **S2**?
- Do I hear something before S1 (an **S4**) or after S2 (an **S3**)?
- Do I hear **murmur** in **systole**? In **diastole**?
- **If** a **murmur** present, note:
  - **intensity, character, duration, radiation**
- As **listen, think** about **mechanical events** that generate the sounds.

# Carotid Arteries

- **Anatomy**
- **Palpation** (ea side separately!)
  - Rhythm
  - Fullness
- **Auscultation**
  - Radiation of murmurs
  - ? **Intrinsic atherosclerosis** – may produce “shsshing” noise known as bruit

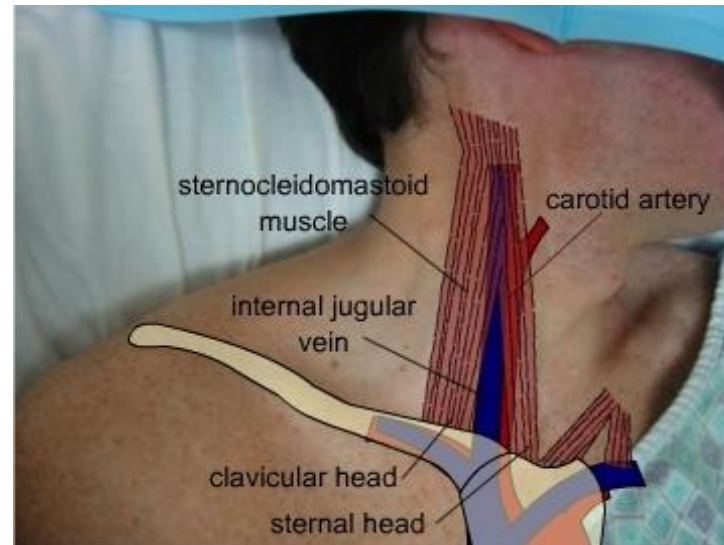
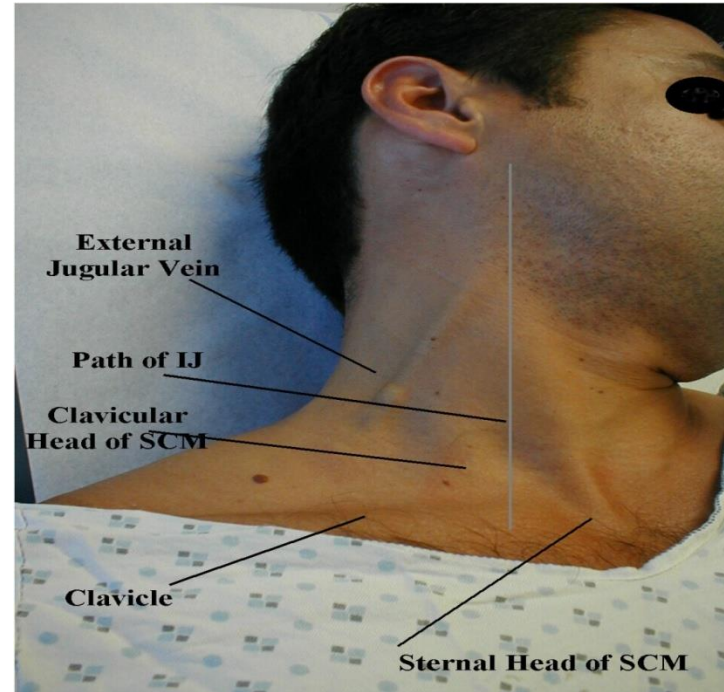


<http://sfgh.medicine.ucsf.edu>



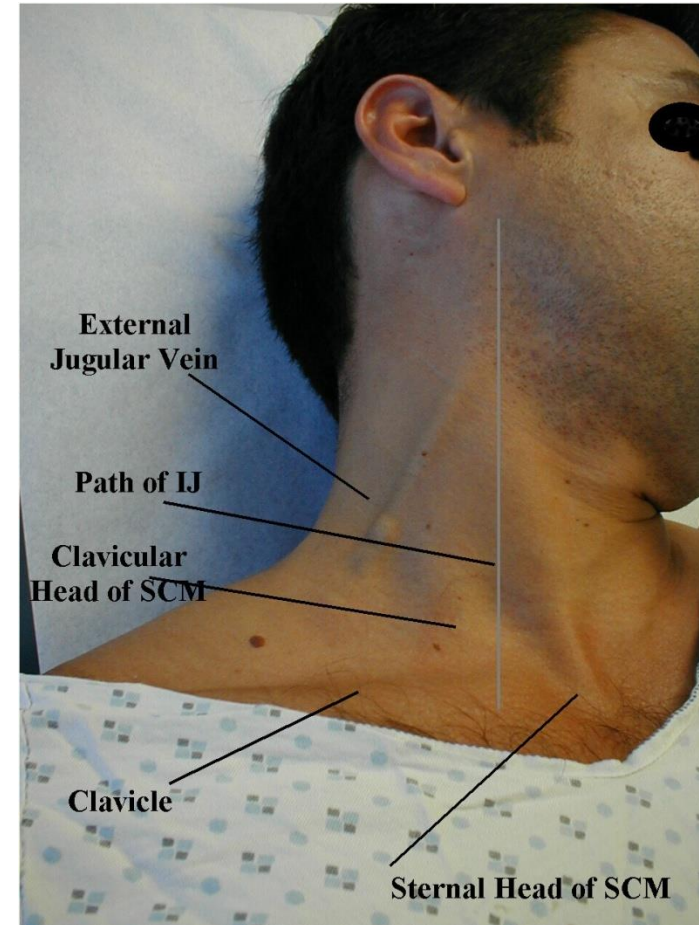
# Jugular Venous Pressure (JVP)

- **Anatomy** of Internal Jugular Vein
- Straight **line** with **RA**
- **Manometer** → reflecting Central Venous Pressure (**CVP**)



# JVP Technique

- **Find correct area** – helps to first identify SCM & triangle it forms w/clavicle
- Look for **multi-phasic pulsations** ('a', 'c' & 'v' waves)
- **Isolate** from **carotid** pulsations, **respirations**
- **Tangential lighting**
- **Hepatojugular reflux** (gentle pressure over liver pushes blood back into IJ & makes pulsations more apparent)

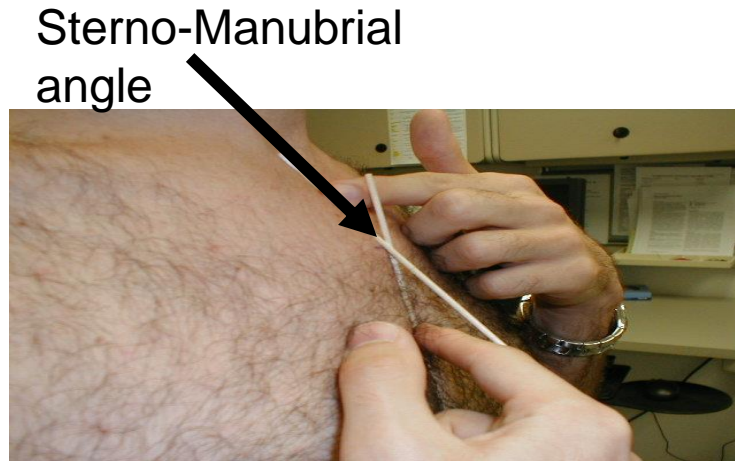


# JVP Technique (cont)

- **JVP = s 5cm** (height sternal manubrium jxn is above RA) + **vertical distance from sternal manubrium jxn to top of pulse wave**
- Normal < 8 cm

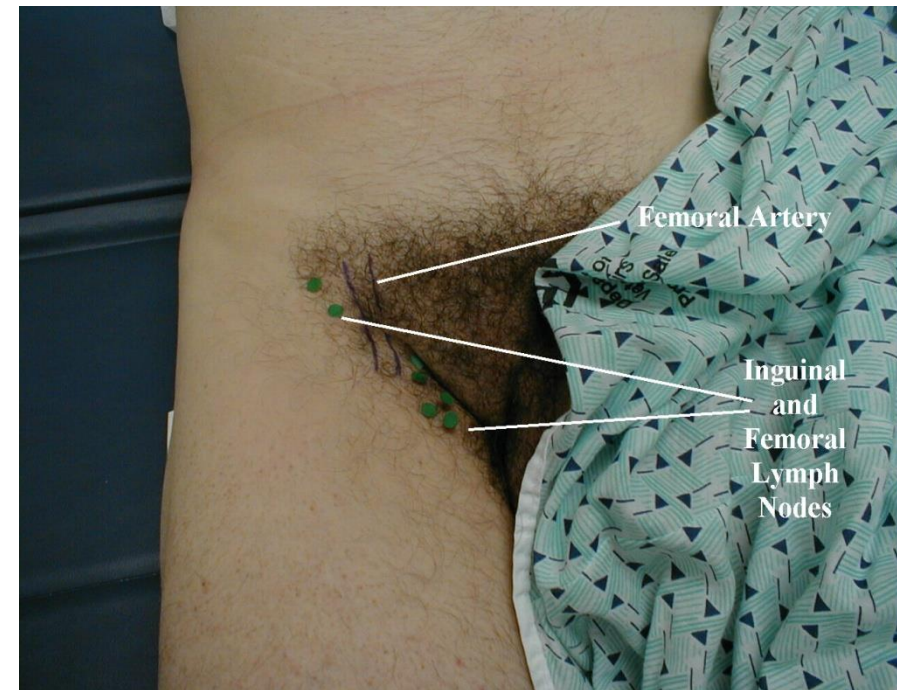
Example of elevated JVP:

[http://meded.ucsd.edu/clinicalmed/cvp\\_movie.htm](http://meded.ucsd.edu/clinicalmed/cvp_movie.htm)



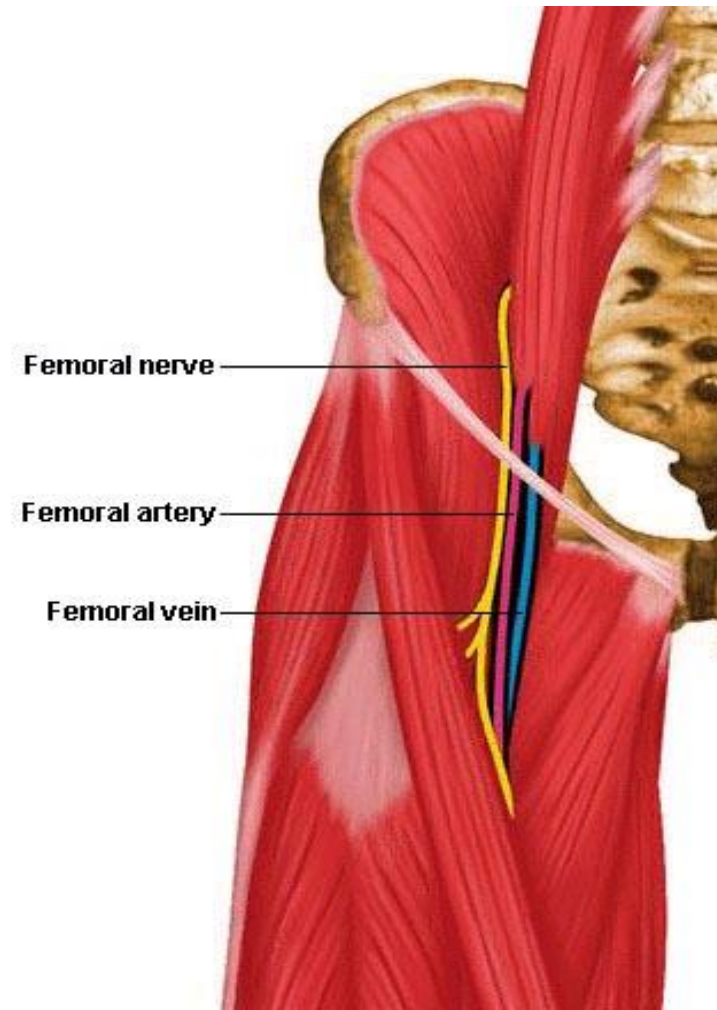
# Lower Extremity Vascular Exam – General Observation, Including Femoral Region

- **Expose** both **legs**, noting: asymmetry, muscle atrophy, joint (knee, ankle) abnormalities
- Focus on **Femoral** Area:
  - Inspect - ? Obvious swelling → femoral **hernia** v large lymph **nodes (rare)**
  - **Palpate** lymph nodes



# Femoral Region (cont)

- Identify **femoral pulse**
- **Listen** over femoral artery with **diaphragm** stethoscope for **bruits** (if suggestion **vascular disease** by hx, exam)



# Popliteal Pulse (behind the Knee)

- W/knee **slightly bent**, push **fingers into popliteal fossa** → assess **popliteal artery**
  - Relevant if **distal pulses diminished**
- Detailed examination of internal structures knee (ligaments, meniscus, etc.) → **MSK Session**



# Vascular Disease of The Lower Leg

## Components:

- outflow (arterial)
- return (venous, lymphatic)

## Clinical Presentations:

### Arterial:

pain (supply-demand)  
wound healing  
RFs for atherosclerosis

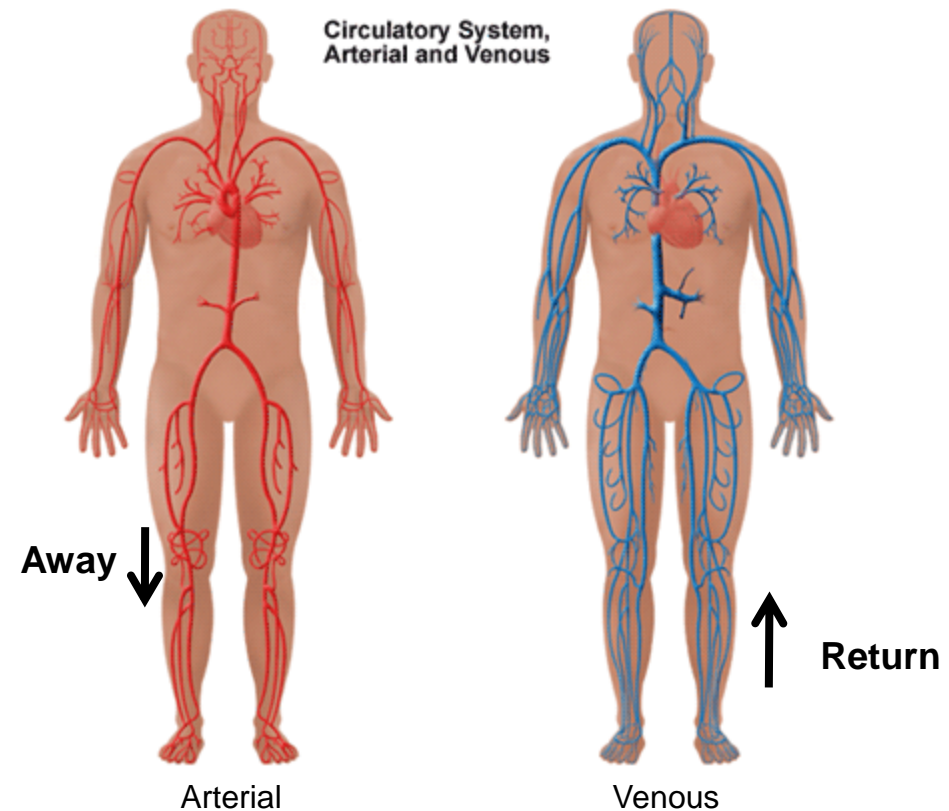
### Venous:

Edema  
Local v systemic etiology

### Lymph (relatively uncommon):

Lymphedema:

From obstruction, disruption



[http://www.reshealth.org/images/greystone/em\\_2396.gif](http://www.reshealth.org/images/greystone/em_2396.gif)

# Clinical Appearance – Varies With Type of Vascular Disease



Peripheral Arterial  
Disease



Venous Insufficiency



Lymphedema



# Feet and Ankles

- Lower leg & feet @ greatest risk **atherosclerosis** (in particular if vascular dz risk factors: DM, HTN, Smoking, Hyperlipidemia, age, known dz elsewhere)
- **Observe**
  - ? **swelling** (edema), **discoloration**, **ulcers**, nail deformities
  - Look @ **bottom of feet**, between toes (problem areas)
  - **Symmetry?**

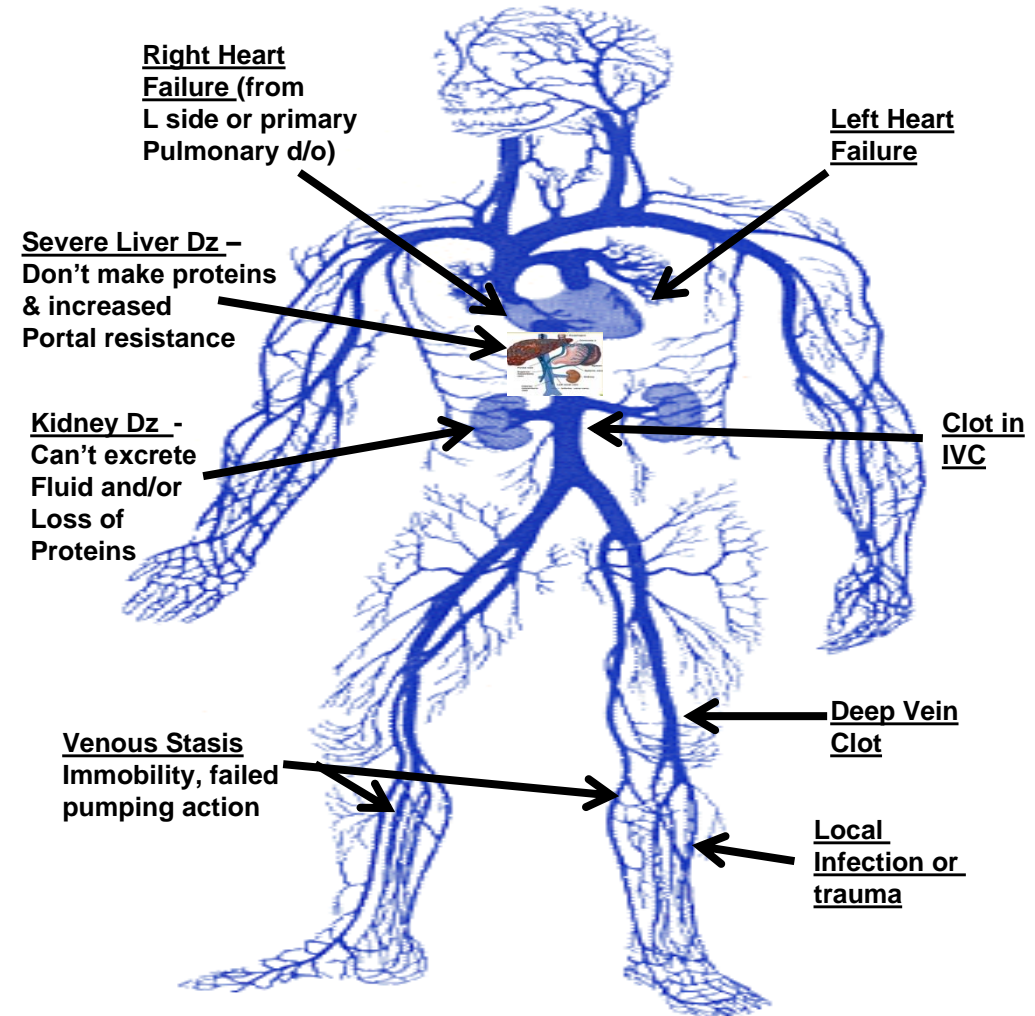
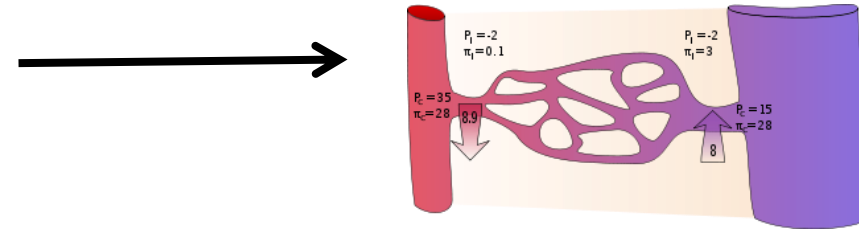


# Feet and Ankles (cont)

- Palpation
  - **Temperature:** Use back of examining hand - warm → inflammation; cool → atherosclerosis &/or hypo-perfusion
  - **Capillary refill:** push on end of toe or nail bed & release → color returns in < 2-3 seconds; longer → atherosclerosis &/or hypo-perfusion

# Feet and Ankles - Edema

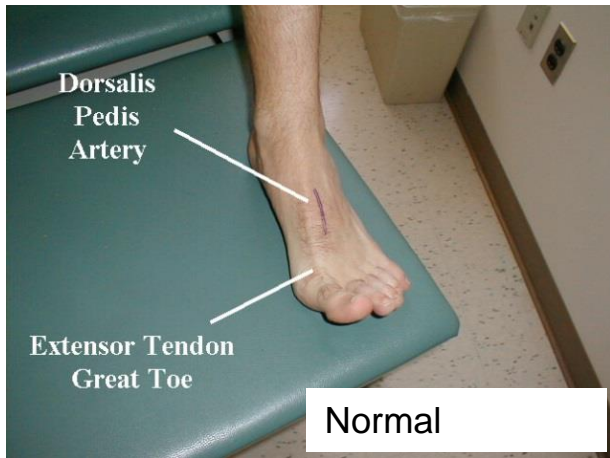
- Change in balance of Starling forces (pressures in vessels v tissues; oncotic forces in vessels v tissues) → Edema
- Local leg problems:
  - Deep Vein Thrombosis
  - Infection, trauma
  - Lymphatic obstruction
- Systemic problems:
  - Heart failure
  - Pulmonary disease (pulmonary hypertension, sleep apnea, thrombosis, etc.)
  - Kidney disease
  - Liver disease
  - Venous stasis



# Quantifying Edema

- **A marker of volume status**
- **Trace** (minimal): subtle loss of tendons on top of foot, contours maleolous
- **Scales (none validated or compared)**
  - 0 to 4+
  - Depth of pitting left (after applying pressure w/a finger) in mm
  - Extent of edema (e.g. limited to feet v up to knee)

# Quantifying Edema



1+	Minimal	Barely detectable impression	2mm
2+	Mild	Slight indentation	4mm
3+	Moderate	Deeper indentation	6mm
4+	Severe	Very deep indentation	8mm

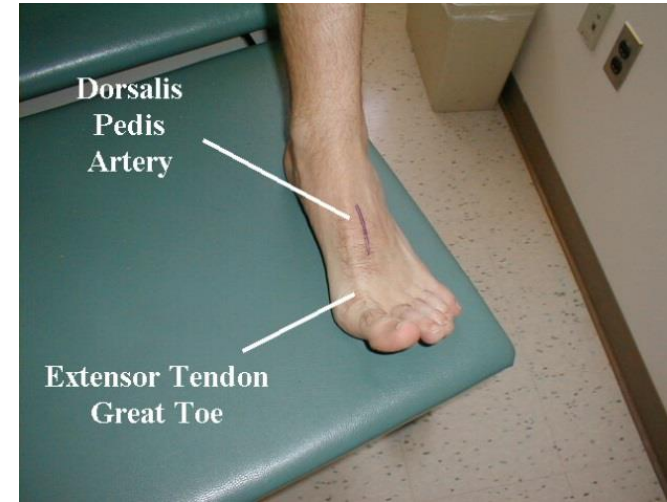
**\*Changes in Weight Very Helpful Clinically for Assessing Total Body Volume and impact of Diuretics\***



Average Marble  
1cm Diameter

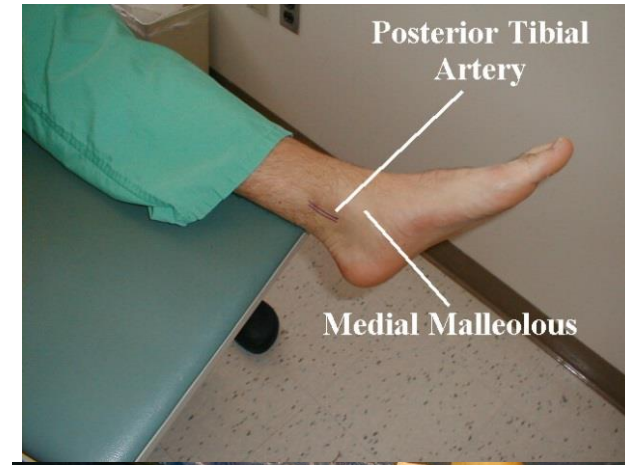
# Dorsalis Pedis Pulse

- Palpate **Dorsalis Pedis** pulse
  - Just **lateral** to **extensor tendon** great toe
  - Use **pads of 2-3 fingers** of examining hand
  - Push gently
  - If unsure whether feeling your pulse v patient's, measure your carotid or their radial w/other hand
  - Graded **0** (not detectable) to **2+** (normal)



# Posterior Tibial Pulse

- Palpate **Posterior Tibial Pulse**
  - Located **posterior** to **medial malleolous**
  - Start on top of malelous & work towards Achilles tendon
  - Use pads of **2-3 fingers**, pushing gently
  - Same rating scale as for dorsalis pedis



# Summary Of Skills



- Wash hands; gown & drape appropriately
- Inspect precordium
- Palpation of RV and LV; Determination PMI
- Auscultation – patient @ 30 degrees
  - S1 and S2 in 4 valvular areas w/diaphragm
    - Try to identify physiologic splitting S2
    - ? Murmurs
  - Assess for extra heart sounds (S3, S4) w/bell over LV
- Carotid artery palpation, auscultation
- Jugular venous pressure assessment
- General lower extremity observation
- Assess femoral area (palpation for nodes, pulse); auscultation over femoral artery
- Knees – color, swelling; popliteal pulse
- Assess ankles/feet (color, temperature, pulses, edema, cap refill)
- Wash hands

## **Pocket Pex Checklist App:**

iPhone: <https://itunes.apple.com/us/app/id779328544?mt=8>

Android: <https://play.google.com/store/apps/details?id=com.physicalexamchecklists.pocketpex&hl=en>



Time Target: ~15 min