

Respiratory and Cardiovascular

Examination Procedures

Order of examinations

- Perform the exams from least sensitive to most sensitive, as least to most invasive is not applicable in the thorax
 - Inspection
 - Palpation
 - Thoracic expansion
 - Tactile fremitus
 - Percussion
 - Comparing tones throughout lung fields
 - Diaphragmatic excursion
 - Auscultation
 - Comparing breath sounds throughout lung fields
 - Vocal resonance

Anatomy and Physiology: Anatomic Landmarks

- Topographic markers
 - Nipples (usually 4th intercostal space)
 - Manubriosternal junction/Angle of Louis (usually 2nd intercostal space)
 - Costal angles (bottom of lung fields)
 - Vertebra prominens (top of lung fields)
 - Clavicles (apex of lung above the clavicles)

Exam & Findings: Equipment

- Marking pencil or eyeliner (silver good for dark skin)
- Centimeter ruler/tape measure
- Stethoscope with bell/diaphragm
- Drapes

Exam & Findings: Inspection

- Chest
 - Shape/symmetry
 - Chest wall movement
 - Superficial venous patterns
 - Prominence of ribs
 - AP vs. transverse diameter
 - Sternal protrusion or invagination
 - Spinal deviation (scoliosis, pain, subluxation)

Exam & Findings: Inspection

- Skin/nails/lips
 - Cyanosis
 - Pallor
- Lips
 - Pursing
- Nostrils
 - Flaring
- Digits
 - Clubbing
- Breath
 - Odor

Exam & Findings: Inspection

- Respiration
 - Rate
 - Depth
 - Rhythm
- Count while palpating pulse

Exam & Findings: Descriptors of Respiration

- Dyspnea
- Tachypnea
- Bradypnea
- Hyperpnea
- Hypopnea
- Kussmaul
- Cheyne-Stokes
- Sighing
- Air trapping
- Biot
- Ataxic
- Apnea

- Paradoxical—occurs when a negative intrathoracic pressure is transmitted to the abdomen by a weakened diaphragm (thorax draws in and abdomen expands on inspiration)
- Causes: phrenic nerve palsy, subpulmonic effusion, pneumothorax, abdominal masses

Exam & Findings: Inspection

- Inspect for airway obstruction
 - Stridor (labored, noisy breathing heard without stethoscope)
 - Nostril flaring
 - Cough
 - Chest retraction

Exam & Findings: Palpation

- Thoracic muscles/skeleton
 - Pulsations
 - Tenderness
 - Bulges/depressions
 - Unusual movement/positions
 - Elasticity of rib cage
 - Immovability of sternum
 - Rigidity of thoracic spine
 - Crepitus
 - Friction rub

Exam & Findings: Palpation

- Perform thoracic expansion
- Perform tactile fremitus
- Evaluate position of trachea (may have already been done with a head and neck evaluation)

Exam & Findings: Percussion

- Percuss chest
 - Posterior
 - Lateral
 - Anterior (sound dulled by pectoralis muscles and breast tissue, so usually not done)
- Compare tones bilaterally
- Measure diaphragmatic excursion
 - Difference between inhalation and exhalation should measure _____

Exam & Findings: Percussion

- Percussion tone indicators for lungs
 - Resonance is **expected**
 - Hyperresonance indicates hyperinflation
 - Dullness indicates diminished air exchange
 - Blood, pus, tumor, edema, proteinaceous fluid

Exam & Findings: Auscultation

- **Normal breath sounds**
 - Vesicular—low pitched, low-intensity sounds heard over healthy tissue
 - Bronchovesicular—heard over major bronchi and are moderate in pitch and intensity
 - Bronchial/tracheal—highest in pitch and intensity, heard over the trachea
 - **Bronchovesicular and bronchial sounds are abnormal if heard over peripheral lung tissue**
- **Abnormal breath sounds**
 - Amphoric—resembles the sound of air blown across a bottle and heard in a large, stiff-walled pulmonary cavity or tension pneumothorax with fistula

Pleural (**outside**) vs. air space (**inside**)

- Consolidation with fluid, pus, or solid mass causes an **increase in fremitus and in breath sounds** (blood, pus, tumor, or edema)
- Excess air in the lungs, pleural thickening, pleural effusion, or bronchial obstruction cause **decreased fremitus and decreased breath sounds**
- **Air is an insulator of sound and vibration; consolidation is an enhancer of sound and vibration**

Exam & Findings: Auscultation

- Adventitious breath sounds
 - Crackles—heard more often with inspiration, caused by disrupted passage of air through the small airways; sibilant=high pitched; sonorous=low-pitched
 - Fine
 - Medium
 - Coarse
 - Rhonchi—deeper, rumbling sounds in expiration, less discrete than crackles; seen more with thick mucous production
 - Wheezes—a form of rhoncus; high-pitched musical sound in inspiration and expiration; caused by high-velocity air flow through narrowed passages
 - Friction rub—occurs outside the bronchial tree; dry, crackling, grating, low-pitched sound
 - Mediastinal crunch—mediastinal emphysema

Exam & Findings: Auscultation

- **Vocal resonance**
- **Normally**, numbers or letters spoken by the patient are heard by the examiner as very **muffled and indistinct**
- Consolidation (by fluid, pus, mass) leads to:
 - Bronchophony—greater clarity and loudness of the sounds (“99” or “123”)
 - Pectoriloquy—if bronchophony is extreme, even whispered sounds can be heard with clarity (“123”)
 - Egophony—the intensity of the spoken voice is increased and the quality is nasal (“e” becomes “a”)

Increased breath sounds

- Solids and fluids transmit sound and vibration better than air
- Pneumonia, masses
- The normal vesicular sounds at the lung bases will be long and loud, rather than soft and short
- And/or bronchial or bronchovesicular sounds will be heard where vesicular sounds are normally heard

Decreased breath sounds

- Anything that causes a “blockage” between the lungs and the stethoscope will cause decreased breath sounds
- Bilaterally:
 - Adipose, muscle, breasts, bilateral pleural effusion (CHF), and hyperaeration (COPD, asthma)
- Unilaterally:
 - Obstruction in bronchus, pneumothorax, pleural effusion, pleural fibrosis, mass

Exam & Findings: Cough

- Describe
 - Moisture: dry or moist; a moist cough may be caused by infection; a dry cough has a variety of causes (cardiac, allergies, mass, HIV)
 - Onset: acute with fever is usually infection; without fever, foreign body or inhaled irritants
 - Frequency: seldom or often present (% of day)
 - Regularity: regular cough is seen with pertussis; irregular cough has variety of causes
 - Pitch/loudness: loud and high-pitched or quiet and low-pitched
 - Postural influences: does it occur after reclining or standing
 - Quality: hoarse (croup); whoop (pertussis); dry and brassy (tumor)

Exam & Findings: Sputum

- Describe
 - Color
 - Consistency
 - Odor

Anatomy and Physiology: Infants and Children

- Fetal lungs contain no air/gas exchange through placenta
- At birth lungs adapt to postnatal function
- Chest circumference same as head circumference until 2 years old
- Chest wall thin/bony structures more prominent and yielding than in adult

Anatomy and Physiology: Pregnant Women

- Mechanical/biochemical factors lead to changes in respiratory function
- Anatomic changes in chest
 - Lower ribs flare
 - Diaphragm rises above usual position

Anatomy and Physiology: Older Adult

- Barrel chest from loss of muscle strength in thorax and loss of lung resiliency
- Skeletal changes of aging emphasize dorsal curve of thoracic spine
- Alveoli less elastic causing fatigue/dyspnea on exertion
- Decrease in vital capacity/increase in residual volume
- Mucous membranes drier

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Exam & Findings: Older Adults

- Chest expansion decreased
- Bony prominences marked
- Kyphosis with flattening of lumbar curve
- Increased AP diameter
- Hyperresonance (percussion) common

Related History: Present Problem

- Coughing
 - Onset
 - Nature
 - Pattern
 - Severity
 - Associated symptoms
 - Efforts to treat
 - Medications

Related History: Present Problem

- Shortness of breath
 - Onset
 - Pattern
 - Severity
 - Associated symptoms

Related History: Present Problem

- Chest pain
 - Onset/duration
 - Associated symptoms
 - Efforts to treat
 - Medications

Heart and Blood Vessels

Examination Procedures

Anatomy and Physiology

- Cardiac cycle
 - Systole - Ventricular contraction ejects blood
 - Diastole - Ventricular relaxation/atria contraction moves blood into ventricle

Anatomy and Physiology

- Systole
 - Ventricles contract, raise pressure
 - Mitral/tricuspid valves **close** (1st heart sound = S1 = lub)
 - Pressure continues to rise
 - Aortic/pulmonic valves **open**
 - Blood ejected into arteries
 - Pressure falls
 - Aortic/pulmonic valves **close** (2nd heart sound = S2 = dub)
 - Mitral/tricuspid valves **open**
 - Blood moves from atria to ventricles (S₃)

Anatomy and Physiology

- Diastole
 - Atria contract as ventricles almost filled
 - Causes complete emptying of atria (S₄)
- Cycle repeats itself
- Cycle slightly slower on right side of heart (splitting)

Exam & Findings: Equipment

- Centimeter ruler
- Stethoscope (bell/diaphragm)

Anatomy and Physiology

- Position variance
 - Body build
 - Chest configuration
 - Diaphragm level
 - Dextrocardia or situs inversus

Exam & Findings

- Inspection
 - Apical impulse (PMI = point of maximum impulse); 5th intercostal space @ mid-clavicular line (know both terms)
- Palpation of the precordium
 - (2,2,3,4,5 intercostal spaces)
 - Thrill (palpable murmur—felt as a vibration)
 - Murmurs that are Grade 3 and above can often be palpated before the auscultation
- Carotid artery palpation

Exam & Findings

- Percussion
 - Of limited value in defining borders of heart
- Heart sound auscultation
 - Aortic valve area 2 RICS
 - Pulmonic area 2 LICS
 - Erb's point (Second pulmonic area) 3 LICS
 - Tricuspid area 4 LICS
 - Mitral area 5 LICS @ midclavicular line
- Memory aid (mnemonic): A PET Monkey

Exam & Findings

- Auscultation
 - Assess overall rate/rhythm
 - Frequency
 - Intensity
 - Duration
 - Pathology

Exam & Findings

- Normal heart sounds
 - S₁/S₂ - most distinct
 - Splitting
 - S₃/S₄ - difficult to hear
- Extra (adventitious) heart sounds
 - Gallops
 - Mitral snaps
 - Ejection clicks
 - Friction rubs

Exam & Findings: Heart

- Heart murmurs
 - Timing/duration
 - Pitch
 - Intensity
 - Pattern
 - Quality
 - Location/radiation
 - Respiratory phase variations

Anatomy and Physiology: Infants/Children

- Heart assumes adult function early in fetal life
- Changes at birth
 - Ductus arteriosus/foramen ovale close
 - Right ventricle assumes pulmonary circulation
 - Left ventricle assumes systemic circulation
- Ventricle muscle mass increases over 1st year
- Heart lies more horizontally/apex higher
 - Adult heart position reached by 7 years old

Exam & Findings: Older Adults

- Slow down pace of exam as cardiac response may be slowed by demands
 - Slow down for the respiratory assessment, too
- Heart rate variable
 - Slower if increased vagal tone
 - Range from low 40s to 100+
 - Ectopic beats common
- Apical impulse harder to find with increased AP chest diameter

Anatomy and Physiology: Older Adults

- Heart size decreases
- Left ventricular wall thickens
- Valves fibrose/calcify
- Endocardium thickens
- Myocardium less elastic
- ECG changes

Anatomy and Physiology: Pregnant Women

- Heart works harder
- Cardiac/blood volume increases
- Heart shifts to more horizontal position
 - SEM (systolic ejection murmur)

Assessment of Blood Vessels

- You've learned part of the cardiovascular assessment
 - Arterial pulses
 - Blood pressure
 - Lymphatic evaluation
 - Lung and thorax evaluation
 - Heart evaluation
- Additional evaluation to learn:
 - Venous system evaluation
 - Lymphatic edema evaluation

Jugular venous pressure and pulse

- The jugular veins (which empty directly into the superior vena cava), reflect the activity of the right side of the heart and offer clues to their competency
- The level at which the jugular venous pulse is visible gives an indication of the right atrial pressure

Jugular veins

- The external jugulars are more superficial than the internal jugulars and are best seen above the clavicle, close to the insertion of the SCM
- The activity of the right heart is transmitted through the jugular veins as a "pulse"
 - It is not a true pulse, which is blood being pushed forward in the arteries; it is a reflection of the right heart activity

Jugular “pulse”

- The jugular pulse has 5 identifiable components:
 - a wave: brief backflow into the vena cava during contraction
 - c wave: backward push produced by closure of the tricuspid
 - x slope: passive atrial filling
 - v wave: increased volume and pressure in right atrium just before contraction
 - y slope: open tricuspid and rapidly filling ventricle

Jugular venous pressure (JVP)

- Place the patient in the supine position for 1-2 minutes, which allows the veins to engorge
- Raise the head until the jugular venous pulsations become evident, approximately 30-45 degrees (palpating contralateral carotid will help differentiate—**JVP cannot be palpated**)
- The jugular pulse may **not** be evident if:
 - Severe right heart failure (seen with seated)
 - Severe volume depletion
 - Obesity

Jugular venous pressure

- Place a ruler at the mid-axillary line at the level of the sternal angle (Angle of Louis)
- Place the bottom of another ruler at the level of the highest jugular pulsation, extending to the first ruler
- Read the vertical ruler at the level of the bottom horizontal ruler
- The vertical distance above the heart is measured
- A value of less than 4 cm is expected
- Suspect right-sided heart failure, fluid volume overload, constrictive pericarditis, tricuspid stenosis, or SVC obstruction if higher

Evaluation of hand veins

- You will need good tangential lighting for this exam
- Place the patient in a semi-recumbent position with the hands on the table (may also be performed with the patient standing)
- Examine and palpate the veins of the hands (which should be engorged) for compressibility and thrombosis
- Slowly raise the hand until the veins collapse
- Confirm this level by repeating the exam
- Bend the elbow and move the hand to the chest
- Note the level, which should be identical to the JVP measured earlier

Hepatojugular reflux

- Caveat: You can erroneously induce a hepatojugular reflux in any patient, as all patients will have an elevated JVP with this maneuver
- Nevertheless, the hepatojugular reflux is exaggerated with right heart failure
- Place your hand firmly in the mid-epigastric region; sustain this pressure for about 10 seconds
- Observe the jugular veins for distention (and veins in the hands)
- If the column of blood in the jugular vein rises rapidly and/or remains distended for more than a few heart beats, suspect right-sided heart failure

Assessment for venous obstruction and insufficiency

- Symptoms of **venous** insufficiency:
 - Pain!!!!
 - Comes on during or after exercise
 - Relieved by rest, but usually takes some time
 - Greater variability than arterial pain in response to intensity and duration of exercise
 - Swelling and tenderness of the muscles
 - Engorgement of superficial veins
 - Erythema and/or cyanosis

Venous insufficiency or obstruction

- Examine for thrombosis
 - Redness, thickening, tenderness of a superficial vein (thrombophlebitis)
 - Deep vein thrombosis has swelling and pain
 - Homan's sign over calf
- Examine for varicosities
 - Dilated and swollen, resulting from incompetence
 - If suspected, have the pt. stand on toes 10 times, which increases palpable pressure
 - If the veins are competent, the dilation will disappear in a few seconds; varicosities will remain dilated longer
- Examine for edema

Venous insufficiency or obstruction

- Examine for edema
- Pitting edema:
 - 1+: slight pitting, disappears rapidly, 1/4" or less
 - 2+: deeper pitting, disappears in 10-15, 1/4-1/2"
 - 3+: noticeably deeper, last 60 sec, 1/2-1"
 - 4+: very deep, lasts 2-5 min, 1" or more
- Brawny edema:
 - Rock hard edema which does not pit; caused by fibrosis of the underlying tissue

Capillary refill time

- The time it takes to refill a capillary bed after occlusion gives some indication of the health of the capillary system
- Compress the fingernail or toenail bed between your fingers for approximately 3 seconds. Compress enough to get blanching of the nail
- Release the pressure and watch for return of the blood and the color to return
- This should take less than 3 seconds