VITAL SIGNS AND PHYSICAL EXAMINATION OF THE CHEST
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Objectives:

1. To understand “normal”
2. To introduce examination of vital signs, pulses and the chest
3. To relate anatomy to physical examination of the chest
4. To learn about use of the stethoscope
5. To develop a routine for examining the chest: Inspection
   Palpation, Percussion, Auscultation

PART 1: VITAL SIGNS

What is a normal temperature?

Normal distribution:

What if normal isn’t healthy?

**Temperature**:

**Oral**:
- Thermometer under tongue, with probe cover
- Wait 3 minutes if mercury, 10 seconds if electronic
- Wait 10 minutes after hot or cold liquids

**Rectal**:
- Use lubrication and probe cover
- Reads 0.4-0.5 degrees C (0.7 to 0.8 degrees F) higher than oral

**Axillary**:
- Poor correlation with rectal temperature
- May be OK in neonates if can’t do rectal thermometer

*Normal oral temperature:* 97 to 99.9 degrees F (36.1 to 37.7 degrees C)
**Blood pressure:**
- Systolic blood pressure is highest pressure in arteries, after heart beats
- Diastolic blood pressure is lowest pressure in arteries, just before heart beats
- Measured indirectly by blood pressure cuff (sphygmomanometer)

**What cuff measures**
- Pressure increased in cuff until it cuts off arterial circulation to the arm
- Pressure decreased by 2 to 3 mm of mercury per second until first blood enters artery, creating turbulence; this causes a sound with each heartbeat
- Sounds continue with each heartbeat until pressure lowers to lowest pressure in artery; then turbulence stops, so sound stops
- Systolic is pressure at first sounds; diastolic is pressure just before sounds stop

**Five phases of Korotkoff (blood pressure) sounds**
- Phase 1: sharp thuds, start at systolic pressure
- Phase 2: blowing sound; may disappear entirely (the auscultatory gap)
- Phase 3: crisp thud, a bit quieter than phase 1
- Phase 4: sounds become muffled
- Phase 5: end of sounds

**Technique of measuring blood pressure**
- Make sure the cuff is the right size (width about 40% of arm’s circumference); cuff will overestimate blood pressure if too small, underestimate if too large.
- Place cuff snugly on proximal arm, on skin (not cloth), centered over brachial artery (most cuffs have markings)
- Support patient’s arm at heart level, using your arm or desk
- Patient should rest for 5 minutes before BP is measured, and should have no caffeine or nicotine for 30 minutes before (JAMA 273, p.1211-1218, 1995)

**Finding the palpable systolic pressure**
- With fingers palpating radial or brachial artery, inflate cuff rapidly until you can’t feel the pulse, then 20 mm higher
- Release cuff at 2 to 3 mm Hg per second until you again feel the pulse; this is the palpable systolic pressure
- Wait 30 seconds before measuring blood pressure
- Measuring palpable pressure first avoids risk of seriously underestimating blood pressure because of the auscultatory gap (mistaking Korotkoff phase 3 for phase 1). Many doctors skip this step for time reasons and instead pump cuff to 200 mm Hg at the next step)

**Measure the blood pressure**
- Place bell of stethoscope (diaphragm is acceptable) over brachial artery
- Rapidly pump cuff to 20 to 30 mm Hg above palpable systolic pressure
- Release pressure in the cuff by 2 to 3 mm Hg per second and listen for Korotkoff sounds, including systolic (first) and diastolic (last)
- Record as systolic/diastolic. Check in both arms; may differ by 10 mm Hg
- If diastolic continues to zero, record diastolic as point when sounds become muffled (phase 4)

**Does this patient have hypertension (high blood pressure)?**
- Need three readings on two occasions to diagnose, unless very high
Normal blood pressure in children:
- 102/55 at 1 year
- 112/69 at 5 years
- 119/78 at 10 years

Blood pressures in adults (JNC VI):
- Optimal: <120/<80
- Normal: <130/<85
- High normal: 130-139/85-89
- Stage 1 hypertension: 140-159/90-99
- Stage 2 hypertension: 160-179/100-109
- Stage 3 hypertension: >180/>110

Pulse
Number of heartbeats (cardiac cycles) per minute

How to measure pulse:
- Use pads of index and long fingers
- Apply gentle pressure
- Count beats for 15 seconds and multiply by 4
- For irregular pulse, count for 60 seconds
- Assess rhythm: regular, irregular or irregularly irregular
- Amplitude:
  - 0 = absent
  - 1+ = diminished
  - 2+ = normal
  - 3+ = increased
  - 4+ = bounding

Where to find pulses:
- Carotid: in neck, medial to and below angle of jaw
- Radial: ventral wrist proximal to base of thumb
- Brachial: antecubital fossa, medial to biceps tendon
- Femoral: in groin, just medial to quadriceps
- Popliteal: middle of popliteal fossa; knee flexed 30 degrees
- Posterior tibial: posterior to medial malleolus, in ankle
- Dorsalis pedis: dorsal foot, lateral to extensor hallucis longus

Why find pulses:
- Peripheral vascular disease: absent or diminished DP and PT pulses
- Obtaining arterial blood for blood gas measurement
- Finding femoral vein for emergency access

Normal pulses:
- Adult: 60 to 100
- Newborn: 120-170
  - 1 year: 80-160
  - 3 years: 80-120
  - 6 years: 75-115
  - 10 years: 70-110

What is your pulse?

Respiration
- Observe rise and fall of chest
- In infants, count for 60 seconds; in adults, 15 or 30 seconds
Normal respiration:
Adults: 12 to 20
Children:
- newborn 30-80
- 1 year 20-40
- 3 years 20-30
- 6 years 16-22

Patterns, what they are and what may cause them:
- Bradypnea: rate under 12: coma, medications, deep sleep
- Tachypnea: rate over 20: anxiety, heart or lung disease, pain
- Hyperpnea: rate over 20 and deep: exercise, anxiety, metabolic
- Sighing: normal if occasional; anxiety if frequent
- Cheyne-Stokes: drugs, CNS damage
- Kussmaul: rapid, deep, labored: metabolic acidosis
- Stridor: harsh, high-pitched inspiration: Danger: airway obstruction

PART 2: EXAMINATION OF THE CHEST

Surface anatomy of the chest
Ribs, clavicles, sternum
Angle of Louis (manubriosternal angle): marker for:
  - Where second rib meets sternum (count ribs from here)
  - Carina of trachea
  - Arch of aorta

Where are the lungs?
Posteriorly: from T1 (first thoracic vertebra) down to T9 (expiration)
  to T12 (inspiration)
  Posterior lungs are mainly lower lobes

Anteriorly: from 4cm above first rib to 6th rib (or so)
  Most of anterior lung is right middle lobe or left lingula (of upper lobe)

Now find them on chest Xrays.
Four methods of chest examination

**Inspection:**

**Shape of chest:**
- Pectus excavatum: common – sternum indented
- Pectus carinatum: sternum protrudes
- Increased anteroposterior (AP) diameter or “barrel chest”
  - A mark of chronic lung disease
  - In normal adults: transverse > AP diameter

**Use of accessory muscles of respiration:**
- These are: sternocleidomastoid (SCM), scalenes and serratus
- Used to help breathe during respiratory distress (or exercise)
- May have intercostal retractions also with respiratory distress

**Palpation**

**Tracheal position:** lateral in tension pneumothorax
**Thoracic expansion:** asymmetric if chest wall injury or part of one lung removed
**Tactile fremitus:** Chest wall vibrations from speech (“ninety-nine”)
  - Should be symmetric – same on both sides
  - **Decreased fremitus:** if something gets between lung and chest wall:
    - Air in pleura (pneumothorax or “collapsed lung”)
    - Fluid in pleura (pleural effusion)
    - Scarred, thickened pleura
  - **Increased fremitus:**
    - In pneumonia, pus in airways increases vibration transmission
      (like wobbling jello) – thus increased fremitus

**Percussion**

**Technique:** index and long finger; move from wrist; strike DIP joint of long finger of other hand; move from side to side, comparing sides
**Sound:** low pitched and drumlike on normal lung; higher pitch on abdomen; flat sound over water and solids (heart, liver, etc.)
- **Hyperresonance:** Louder and hollower than usual
  - Pneumothorax (air in pleura)
  - Chronic obstructive pulmonary disease with hyperinflation
- **Dullness to percussion** (more liquid or solid)
  - Pleural effusion (fluid in pleura)
  - Consolidation (lung area full of pus from pneumonia)
**Diaphragmatic excursion:** should be 3 to 5 cm from inspiration to expiration
Auscultation

**Technique**: Diaphragm of stethoscope; move from side to side

**Normal breath sounds**:
- Vesicular: most of lung; breathy sound of air moving in small airways and alveoli
- Bronchovesicular: medium pitch; heard in central chest; if heard elsewhere, a sign of consolidation
- Bronchial: higher pitch, heard over trachea; abnormal elsewhere

**Softer breath sounds if**:
- Air around lung (pneumothorax)
- Fluid around lung (pleural effusion)
- Obesity or pleural thickening/scarring
- Moving less air (severe chronic obstructive lung disease or asthma)

**Vocal resonance**: transmission of patient’s voice
- The auditory equivalent of tactile fremitus
- Bronchophony: increased clarity of words, e.g. in area of pneumonia
- Whispered pectoriloquy (even a whisper is clear to stethoscope – an extreme form of bronchophony)
- Egophony: patient says EE and stethoscope hears A – ditto

**Extra sounds**:
- **Crackles**: signs of water in alveoli (heart failure), pus in alveoli (pneumonia), or scarring (pulmonary fibrosis)
- **Wheeze**: high pitched, continuous whistles, usually in expiration; a sign of asthma or, if localized, tumor or foreign body
- **Rhonchi**: low pitched, snore-like, in inspiration and expiration; originate in larger airways than wheezes; a sign of bronchitis
- **Friction rub**: a dry, leathery sound in inspiration and expiration; a sign of inflammation of pleura
CASE 1: A man with shortness of breath
A 25 year old man comes to you because of sudden onset of shortness of breath.

Diagnostic possibilities include:
- Pneumothorax (“collapsed lung”, with air around the lung)
  - Tension pneumothorax (Air around lung keeps expanding)
- Pleural effusion (fluid around the lung)
- Anxiety
- Trauma (gunshot or knife wound, rib fracture)

Inspection: What might you see by looking at him?

Palpation: Can tactile fremitus help you make the diagnosis?

Percussion: How can this help?

Auscultation: What do you expect to find?

CASE 2: Another man with shortness of breath
A 55 year old man is always short of breath, but has felt more short of breath and coughed more for a week.

Inspection: What do you see?

Palpation: What might you notice about his chest expansion?

Percussion: What do you expect to find?

Auscultation: What do you expect?

CASE 3:
This man is short of breath and has fever and a cough. Xray shows upper lobe pneumonia.

Inspection: What findings might you expect?

Palpation: What do you expect to find on tactile fremitus?

Percussion: What findings do you expect?

Auscultation: What do you expect to hear?