



## CHAPTER 5

# Chest/Lungs

### Basic Examination

#### Percuss lung fields

**PROCEDURE:** With the patient sitting up and gently leaning forward:

1. Method of percussion: use two-digit technique (Fig 5-1)
2. Percuss the posterior fields: four pairs (Fig 5-2: sites 1–8) of sites slightly medial to the post-midclavicular line; compare one side to the other; can perform from the top down or from the bottom up
3. Instruct the patient to raise both arms; percuss in the midaxillary line (Fig 5-3: sites 9–12); compare to other side at each level
4. Instruct the patient to resume original position with arms at sides; percuss the anterior upper zones in the anterior midclavicular line (Fig 5-4: sites 13–16)
5. Percuss in the apices, that is, between the lateral neck and the shoulder (Krönig's isthmus; Fig 5-4: sites 17–18)

**OUTCOME:** If there is a tympanic note:

- ◆ **emphysema**
- ◆ **pneumothorax**

If dull note:

- ◆ **pleural effusion**
- ◆ **consolidation**

If dull note over left anterior chest: ◆ **normal cardiac dullness**

#### Feel for tactile fremitus

**PROCEDURE:** Instruct the patient to repeat the word “coin” (*/cooin/* sound), or the words “toy” or “boy” (the */eu/* diphthong). Use the palms of both hands simultaneously on the posterior, lateral, and anterior aspects of the lung fields to feel the transmission of the sound. (See Figs 5-2, 5-3, and 5-4 for the sites and sequence of tactile fremitus.)

**OUTCOME:** If there is increased transmission over an area of dullness:

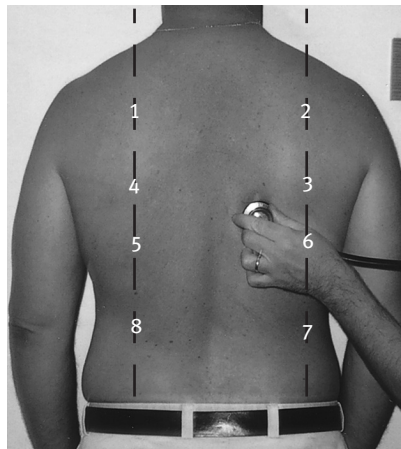
- ◆ **consolidation with open airways**

If decreased transmission over an area of dullness:

- ◆ **pleural effusion**
- ◆ **pneumonectomy**
- ◆ **consolidation without open airway**



**Figure 5-1 Method to percuss.** Two-digit technique: Note the position of fingers; use slightly flexed third digit to tap on the distal interphalangeal surface of the other third digit applied to chest wall surface.



**Figure 5-2 Posterior chest sites for percussion, tactile fremitus, and auscultation.** Note the four pairs of sites (1–8); use one side to compare with the other at each level. The dashed lines are the posterior midclavicular lines.



**Figure 5-3 Lateral chest sites for percussion, tactile fremitus, and auscultation.** Note the two pairs of sites (9–12); use one side to compare with the other at each level. The dashed lines are the midaxillary lines.

### Auscult lung fields

**PROCEDURE:** With the patient sitting up and leaning forward, use the diaphragm to auscult the lung fields. Instruct the patient to inhale and exhale deeply (but not maximally or forcefully). Cover the lung fields as described in Figs 5-2, 5-3, and 5-4 for the sites of auscultation. Describe the intensity of the breath sounds, and note any adventitious, that is, extra, sounds.

**OUTCOME:** If there is increased intensity of breath sounds over an area of dullness: ♦ **consolidation with open airways**

If decreased intensity of breath sounds over an area of dullness:

♦ **pleural effusion**

♦ **pneumectomy**

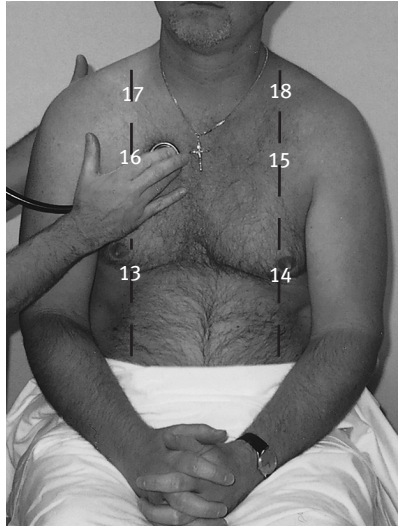
♦ **consolidation with closed airways**

If vesicular breath sounds: ♦ **normal**

If wheezes are present: ♦ **airway obstruction, partial**

If inspiratory wheezes are present: ♦ **chronic bronchitis**

If expiratory wheezes are present: ♦ **asthma**



**Figure 5-4** Anterior sites for percussion, tactile fremitus, and auscultation. Note the three pairs of sites (13–18); use one side to compare with the other at each level. Sites 17 and 18 are above the clavicles in an area called *Krönig's isthmus*. The dashed lines are the anterior midclavicular lines.

If there is a high-pitched inspiratory sound (stridor):

◆ **upper airway obstruction, almost complete**

If there are sounds that could be likened to the rubbing of hairs next to the ears: ◆ **crackles**

If rattling-type sounds that could be likened to something needing to be coughed up (secretions in tubes): ◆ **rhonchi**

### Inspect mucous membranes

**PROCEDURE:** Inspect the mucous membranes and nail beds. Use your own mucous membranes as control.

**OUTCOME:** If the mucous membranes are pink: ◆ **normal**

If bright red: ◆ **carbon monoxide poisoning**

If blue: ◆ **cyanosis**

If pale: ◆ **anemia**

### Observe patient's positioning

**PROCEDURE:** Instruct the patient to assume a position in which the dyspnea and tachypnea are minimized. Note that position.

**OUTCOME:** If the patient assumes an upright sitting position, leaning forward with legs dangling over the sides of the table (Fowler's

position or severe orthopnea):

◆ **pulmonary edema, that is, heart failure**

If the patient assumes a supine position, indicating that it is easier to lie flat than sit up (platypnea):

◆ **ASD (see p. 91)**

◆ **end-stage liver disease (see p. 132)**

If the patient assumes a left or right decubital position (trepopnea): ◆ **pleural effusion, ipsilateral to the side down**

If the patient has head anteriorly displaced at the neck, nose upward (“sniffing the flowers” position):

◆ **upper airway obstruction—epiglottitis or Ludwig’s angina**

### Inspect chest wall

**PROCEDURE:** With the patient standing in anatomic position, visually inspect the skeletal components of the chest and chest wall.

**OUTCOME:** If there is an increased anteroposterior (AP) diameter (i.e., a barrel-shaped chest):

◆ **severe chronic obstructive pulmonary disease (COPD)**

If anterior protrusion of the sternum:

◆ **pectus carinatum (“pigeon chest”)**

If the inferior sternum and xiphoid are inverted (Fig 5-5):

◆ **pectus excavatum (“funnel chest”)**

If there is a normal AP diameter with the ribs flaring anteriorly and inferiorly (concave) to form a groove bilaterally involving ribs 7 to 10 (Harrison’s groove): ◆ **rickets in the past**



**Figure 5-5 Pectus excavatum.** Congenital chest wall abnormality in which there is posterior displacement of the lower sternum and xiphoid process; may lead to restrictive pulmonary disease.

### Inspect sternocleidomastoid muscles

**PROCEDURE:** With the patient sitting and breathing at baseline, visually inspect the sternocleidomastoid muscles for contractions during the respiratory cycle.

**OUTCOME:** If there is a contraction with each inspiration:

◆ **COPD**

◆ **asthma, acute exacerbation**

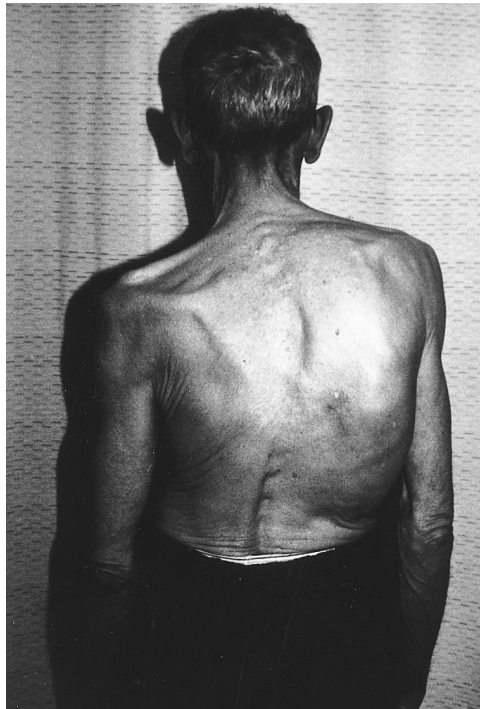
If bilateral muscular hypertrophy: ◆ **COPD, severe**

### Inspect thoracic spine

**PROCEDURE:** With the patient in an upright anatomic position facing away from you, visually inspect the spinal column itself. Repeat after instructing the patient to turn to a profile view.

**OUTCOME:** If there is a left tilt to the thoracic spine: ◆ **thoracic levoscoliosis**

If a right tilt (Fig 5-6): ◆ **thoracic dextroscoliosis**



**Figure 5-6 Marked thoracic dextroscoliosis.** This was accentuated upon forward flexion of the back (not shown); patient had significant restrictive pulmonary disease due to this scoliosis.

If in profile, the cervical spine is lordotic, the thoracic spine kyphotic, the lumbar spine lordotic, and the sacral spine kyphotic: ♦ **normal**

If there is a marked increase in thoracic kyphosis:

♦ **dowager's hump of osteoporosis, also known as *hunch* or *humpback***

### Inspect intercostal muscles

**PROCEDURE:** Visually inspect the intercostal muscles for movements in the intercostal spaces during the respiratory cycle.

**OUTCOME:** If there is diffuse mild inward movement with inspiration and a mild outward movement with expiration: ♦ **normal**

If exaggerated diffuse inward movement with inspiration (retraction) and outward movement with expiration (bulging):

♦ **COPD, acute exacerbation**

♦ **COPD, severe**

If a focal bulging in inspiration and expiration:

♦ **pleural effusion**

### Inspect abdomen for movements during respiration

**PROCEDURE:** With the patient supine, visually inspect the abdominal movements with the patient's breathing at baseline.

**OUTCOME:** If the abdomen moves outward during inspiration and inward during expiration: ♦ **normal**

If it moves inward during inspiration and outward during expiration (paradoxical respirations):

♦ **paralysis of the diaphragm**

### Visually inspect expectorated sputum

**PROCEDURE:** Visually inspect freshly expectorated sputa.

**OUTCOME:** If clear fluid:

♦ **spit**

♦ **atypical pneumonia, that is, interstitial**

If yellow-green (purulent):

♦ **asthma**

♦ **bronchitis**

♦ **typical pneumonia, that is, consolidative**

If purulent with red streaks:

♦ **bronchitis**

♦ **typical pneumonia, that is, consolidative**

If frothy and clear but pink-tinged:

♦ **pulmonary edema, that is, heart failure**

If frank blood: ♦ **hemoptysis**

**Inspect fingers for signs of clubbing:** See Chapter 8, under Advanced Examination (Fig 8-9, p. 184).

## Advanced Examination



### APPROACH TO A PATIENT WITH CONSOLIDATION OR EFFUSION

**Percuss lung fields:** As in Basic Examination.

**Feel for tactile fremitus:** As in Basic Examination.

**Auscult lung fields:** As in Basic Examination.

**Visually inspect expectorated sputum:** As in Basic Examination.

#### Auscult with diaphragm: egophony

**PROCEDURE:** With the patient sitting and breathing at baseline, use the diaphragm to auscult over the area of presumed consolidation or effusion while the patient is singing the vowel sound /e/: “eeeee.” Use the normal lung areas as a control.

**OUTCOME:** If the /e/ sound remains: ♦ **normal**

If an /e-a/ (an /a/ sound like a bleating sheep, or a hard /a/) is heard throughout the area of dullness: ♦ **consolidation**

If an /e-a/ (an /a/ sound like a bleating sheep, or a hard /a/) is heard, localized to the superior surface of the dullness:

♦ **pleural effusion**

If no sound is transmitted: ♦ **pneumectomy (lobectomy)**

### APPROACH TO A PATIENT WITH SUSPECTED CONGESTIVE HEART FAILURE

**Percuss lung fields:** As in Basic Examination.

**Auscult lung fields:** As in Basic Examination.

**Inspect mucous membranes:** As in Basic Examination.

**Observe patient’s positioning:** As in Basic Examination.

**Basic cardiology examination:** See Chapter 4, Basic Examination, p. 70.

#### Auscult after deep cough

**PROCEDURE:** With the patient sitting in an upright position, use the diaphragm to auscult the area of crackles before and after a deep cough.

**OUTCOME:** If there are localized, constant crackles that decrease after cough:

♦ **atelectasis**



If localized crackles that do not decrease after a cough:

- ◆ **consolidation**

If diffuse crackles that do not change with a cough:

- ◆ **pulmonary edema, that is, heart failure**
- ◆ **interstitial lung disease**
- ◆ **Atypical pneumonia, that is, interstitial**

### **Auscult: describe crackles**

**PROCEDURE:** Use the diaphragm to auscult the area of crackles. Attempt to determine the quality of the crackles.

**OUTCOME:** If the crackles are fine—high pitched, dry, like Velcro being ripped apart: ◆ **interstitial lung disease**

If coarse—low pitched, popping wet, like beer bubbles:

- ◆ **pulmonary edema, that is, heart failure**

## **APPROACH TO A PATIENT WITH OBSTRUCTIVE LUNG DISEASE**

**Auscult lung fields:** As in Basic Examination.

**Inspect sternocleidomastoid muscles:** As in Basic Examination.

**Inspect intercostal muscles:** As in Basic Examination.

**Inspect mucous membranes:** As in Basic Examination.

**Inspect chest wall:** As in Basic Examination.

**Inspect fingers for signs of clubbing:** See Chapter 8, under Advanced Examination (see Fig 8-9, p. 184).

**Visually inspect expectorated sputum:** As in Basic Examination.

### **Measure forced expiratory time**

**PROCEDURE:** Place the bell of a stethoscope over the trachea in the jugular notch. Instruct the patient to exhale with maximal effort from the point of deepest inspiration. Measure the time from the beginning to the last point of audible exhalation.

**OUTCOME:** If <6 seconds: ◆ **normal**

If >6 seconds: ◆ **airway obstruction (i.e., COPD or asthma)**

### **Study movement of chest and hemidiaphragm**

**PROCEDURE:** With the patient sitting in anatomic position, place both hands on the anterior inferior costal margins with the thumbs on the medial aspects of the cartilages adjacent to the xiphoid, fingers pointing upward and laterally. Instruct the patient to inspire and expire maximally. Note any differences between the two sides.

Perform again on upper anterior chest and once again on lower posterior chest.

**OUTCOME:** If, during deep inspiration, the fingers symmetrically lateralize and the angle between the thumb and fingers becomes more obtuse: ♦ **normal**

If minimal movement of thumb and fingers:

♦ **Restrictive disease, paralysis of hemidiaphragm**

## PULMONARY

*“Clear to P/A (percussion and auscultation)”*

### A. Chest wall configuration

Note symmetry of chest to expansion

### B. Percussion

Note sites/areas of abnormal dullness (fluid) versus tympany (gas/emphysema) versus normal

### C. Tactile fremitus

Note sites/areas of abnormal increased (consolidation) versus decreased (effusion)

### E. Breath sounds

Note sites/areas of increased (consolidation) versus decreased (effusion or emphysema)

### E. Adventitious sounds

Adventitious sounds and their locations—wheezes, rhonchi, crackles or rubs.

### A. Chest wall configuration and symmetry

### B. Percussion

Draw on areas of dullness or tympany.

### C. Tactile fremitus

Draw on areas of increased or decreased fremitus.

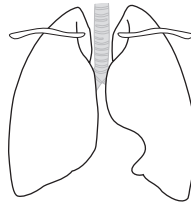
### D. Breath sounds

Draw on areas of increased or decreased breath sounds.

### E. Adventitious sounds

Draw on location of wheezes, rhonchi, crackles and rubs.

#### Anterior Chest



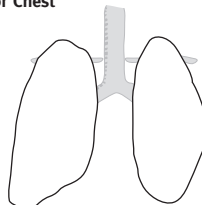
#### Left Chest



#### Right Chest



#### Posterior Chest



## Diagnoses

**Airway obstruction:** See Asthma, Chronic bronchitis, Emphysema, and Epiglottitis.

### Asthma

Reversible hyperactivity of the smooth muscle in the walls of the bronchi with hypoventilation due to atopic or cold/exercise-mediated or reflux of gastric acid mechanisms. Symptoms include cough, shortness of breath, and diffuse chest tightness; may be precipitated in a supine position or by exercise. Signs include diffuse wheezing, intercostal retractions, and use of sternocleidomastoid muscles. If related to atopic disease, may have associated urticaria (Plate 25) or angioedema (see Fig 2-8, p. 15); if severe, may have a paucity of wheezes, diminished breath sounds, and cyanosis. Evaluation is by pulse oximetry and, if severe, arterial blood gas. Treatment includes inhaled  $\beta_2$ -agonists, glucocorticoids, and oxygen supplementation.

### Atelectasis

Loss of gas from alveolar sacs in an area of the lung due to partial obstruction or decreased inspiration volume. Symptoms and signs include localized crackles (rales), normal percussion, and mild egophony throughout the area; the crackles usually clear after deep cough. Treat the underlying disorder and perform an aggressive incentive spirometry, especially if in a postoperative patient.

### Atypical pneumonia, interstitial

Diffuse inflammation in the lung interstitium due to *Mycoplasma pneumoniae*, *Legionella* species (spp), viruses including influenza, or *Pneumocystis carinii*. Symptoms include a hacking, nonproductive cough; malaise; and shortness of breath. Signs include diffuse crackles and occasional wheezes and low-grade or spiking fever. Evaluation includes performing chest radiography for diffuse interstitial infiltrate and pulse oximetry for hypoxemia; sputum is scant and thus is of little diagnostic utility. Treatment is with systemic antibiotics—erythromycin-based regimens for *Mycoplasma/Legionella*; trimethoprim (TMP)/sulfa-based regimen for pneumocystitis.

### Bronchitis

Acute inflammation of airways due to a viral or bacterial etiology. Symptoms and signs include sputum that is yellow or green with red streaks, low-grade fever, scattered wheezes, and diffuse rhonchi. Chest radiography is often normal. Treatment is with antibiotics and inhaled  $\beta_2$ -agonists.

### Chest wall deformities

Congenital or acquired defects in the chest wall that may lead to restrictive lung disease. Symptoms and signs include the deformities themselves: **pectus excavatum**, **pectus carinatum**, **thoracic levoscoliosis**, **thoracic dextroscoliosis** (see Fig 5-6), or **dowager's hump** (thoracic kyphosis). Evaluation includes pulmonary function tests (PFTs), which reveal normal forced expiratory volume in 1 second (FEV<sub>1</sub>) and decreased forced vital capacity (FVC; restrictive pattern). Referral to a respiratory therapist/pulmonologist may be indicated, as well as preventive management for osteoporosis.

### Chronic bronchitis

Minimally reversible constriction of the bronchi, with hypoventilation and chronic cough: defined as a persistent productive cough for >3 months for 2 consecutive years. Chronic bronchitis is often concurrent to emphysema. Symptoms include a productive cough of purulent sputa and dyspnea. Signs include diffuse scattered wheezes, rhonchi, cyanosis, barrel chest deformity, pursed-lip breathing, and use and even hypertrophy of sternocleidomastoid muscles. An acute increase in symptoms and signs indicates acute exacerbation. Evaluation includes pulmonary function tests (PFTs), which reveal decreased FEV<sub>1</sub>, normal FVC, decreased FEV<sub>1</sub>/FVC ratio to <60%, and normal residual volume and diffusing capacity. Treatment includes inhaled anticholinergic agents such as ipratropium and cessation of smoking.

**Chronic obstructive pulmonary disease:** See Emphysema and Chronic bronchitis.

**Clubbing:** See Hands, Fingers in Chapter 8, p. 197.

**Consolidation:** See Typical pneumonia.

### Crackles

Discrete finding on auscultation indicative of interstitial lung disease, pulmonary edema, or atypical pneumonia.

### Cyanosis

Elevated deoxyhemoglobin due to profound hypoxemia from hypoventilation, pulmonary hypertension, pulmonary edema, or interstitial lung disease. Symptoms and signs include blue lips, mucous membranes, and nail beds, along with concurrent manifestations of the underlying etiology. Evaluation includes arterial blood gases. Treatment includes supplemental oxygen and is directed toward the underlying etiology.

**Dowager's hump:** See Chest wall deformities.

### Emphysema

Destruction of the alveolar septa with expansion of the air spaces and a decrease in lung compliance due to smoking cigarettes or  $\alpha_1$ -antitrypsin defi-

ciency, or both; usually concurrent to chronic bronchitis. Symptoms include a nonproductive cough, mild to modest dyspnea, and dyspnea on exertion. Signs include barrel chest deformity, flattened diaphragms, pursed lipped breathing, tympany to percussion, diffusely decreased breath sounds, rare cyanosis, or wheezing. Acute increase in symptoms and signs indicates acute exacerbation. Evaluation includes PFTs, which reveal decreased FEV<sub>1</sub>, normal FVC, decreased FEV<sub>1</sub>/FVC ratio to <60%, increased residual volume, and decreased diffusing capacity. Treatment includes inhaled anticholinergic agents such as ipratropium and cessation of smoking.

### **Epiglottitis**

Inflammation due to infection of the larynx superior to the vocal cords with *Staphylococcus aureus*, *Streptococcus pneumoniae*, β-hemolytic streptococci in adults, or *Haemophilus influenzae* in children. Symptoms include sore throat, fever, dysphagia, and odynophagia with drooling. Signs include “sniffing the flower” position of head, drooling, and auscultable and even audible stridor. Do not use a tongue depressor in examination, as this may precipitate complete **upper airway obstruction**. Evaluation includes lateral neck films, which may reveal a narrowed epiglottis. Treatment includes emergency referral to an ear, nose, and throat surgeon and parenteral antibiotics.

### **Hemoptysis**

Blood in sputa due to acute bronchitis, mycobacterial disease, or neoplastic disease. Symptoms and signs are specific to the underlying etiology: in acute bronchitis, wheezing; in mycobacterial disease, upper lobe cavitory disease and tympany. Evaluation includes a chest radiograph to assist in localization. Treatment is directed toward the underlying etiology.

**Hydropneumothorax:** See Pneumothorax.

### **Interstitial lung disease**

Infiltration of lung tissue by fibrous tissue, infection (mycobacterium or atypical pneumonia), or an inhaled agent (silicosis). Symptoms and signs include shortness of breath and dyspnea during exercise; clubbing (see Fig 8-9, p. 184); cyanosis; dry, “Velcro-sounding” crackles; and right heart failure are also present. Evaluation and treatment include arterial blood gases, chest radiography, and referral to a pulmonologist.

**Large cavity/bullous disease:** See Emphysema and Hemoptysis.

### **Paralysis of hemidiaphragm**

Damage to the phrenic nerve, often after surgery or trauma, or high (C3/C4) cervical cord damage, resulting in restrictive-type pulmonary disease. Symptoms and signs, which are usually minimal unless bilateral, include rapid shallow breathing, use of accessory muscles, and cyanosis. No adventitious

sounds are present, but minimal movement of the diaphragm with inspiration may be detected by percussion. Concurrent findings related to quadriplegia or paraplegia are not uncommon. Evaluation includes PFTs, which reveal normal FEV<sub>1</sub> and decreased FVC (restrictive pattern). Management includes using a tilting bed.

**Pectus carinatum:** See Chest wall deformities.

**Pectus excavatum:** See Chest wall deformities.

### **Pleural effusion**

Abnormal quantity of fluid in the pleural space, either transudative—due to nephrosis, cirrhosis, congestive heart failure (CHF), or hypoalbuminemia, or exudative—due to infection, neoplasia, or a connective tissue disorder. Symptoms include dyspnea, orthopnea, and trepopnea. Signs include dullness to percussion, decreased tactile fremitus, decreased to absent breath sounds throughout the area of dullness, and egophony at the superior surface of the dullness. Evaluation with chest radiographs reveals blunting of the costophrenic angle; if it is quite large, radiographs also reveal a diffuse fluid area with a meniscus at the superior side without any air bronchograms. A thoracentesis should be performed and the fluid sent for total protein and lactic dehydrogenase (LDH) testing. Total protein and LDH levels should also be drawn on the patient's plasma. Treatment is of the underlying condition.

### **Pneumonectomy/lobectomy**

Surgical removal of a lung (called *lobectomy* if one lung is removed). Symptoms and signs include a scar, dullness to percussion, and an absence of all breath sounds. Obtain patient history and a chest radiograph for confirmation.

### **Pneumothorax**

Leakage of air into the pleural space. The leakage may be iatrogenic (as a complication of thoracentesis or central line placement), traumatic (from rib fractures or penetrating chest wounds), or spontaneous (with panacinar emphysema or *P. carinii* pneumonitis). Two types of pneumothoraces are recognized: simple—maximal at outset; tension—progressive, leading to mediastinal shift. Symptoms include pleuritic chest pain, dyspnea, tachypnea, and hiccups. Signs include pleural rub and tympany, with marked decreased breath sounds over the site. Other symptoms and signs are specific to diagnosis: a shift of the mediastinum and trachea to the contralateral side, along with progressive cyanosis and respiratory embarrassment in tension pneumothorax. Evaluation includes a chest radiograph. With symptomatic cases of pneumothorax or any tension pneumothorax, emergent placement of a chest tube is indicated.

**Pulmonary edema:** See Heart failure in Chapter 4.

**Restrictive lung disease:** See Chest wall deformities.

### **Rhonchi**

Discrete finding on auscultation indicating fluid, phlegm, or foreign material in the airways.

### **Rickets**

Poor bone formation due to vitamin D deficiency in childhood. Signs include Harrison's sulcus sign and bowing of the tibiae. Treatment is through prevention—adequate vitamin D during childhood.

**Thoracic levo-/dextroscoliosis:** See Chest wall deformities.

### **Typical pneumonia**

**Consolidation** in the alveoli in one or more of the lobes due to *S. pneumoniae*, *H. influenzae*, and anaerobes. Symptoms include fever, productive cough with yellow-green sputa, malaise, and shortness of breath. Signs include dullness to percussion, increased tactile fremitus, bronchial breath sounds, and egophony, both throughout the area of dullness. The sputa will be fetid sputa if the agent is anaerobes. Evaluation includes chest radiography, which reveals lobar infiltrate; pulse oximetry, which demonstrates hypoxemia; and sputum culture, which reveals multiple PMNs and organisms. Treatment includes systemic antibiotics, including a second- or third-generation cephalosporin and a macrolide or a fluoroquinolone.

**Upper airway obstruction:** See Epiglottitis and Ludwig's angina in Chapter 2.