Ministry of Health of Ukraine
Kharkiv National Medical University

AUSCULTATION AS METHOD OF PHYSICAL EXAMINATION OF THE LUNGS. AUSCULTATION OF THE LUNGS TECHNIQUE. THE MAIN RESPIRATORY SOUNDS

Methodical instructions for students

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AUSCULTATION OF THE LUNGS

Auscultation of the lungs is the most importing examining technique for assessing airflow through the tracheobronchial tree.

Auscultation involves:

1. listening the sounds generated by breathing – breath sounds (respiratory sounds);
2. listening for any adventitious (added) sounds.

Auscultation technique. Listen to the respiratory sounds with the diaphragm of a stethoscope after instructing the patient to breath deeply through a nose with close mouth. Be alert for patient discomfort due to hyperventilation (light headedness, faintness), and allow the patient to rest as need.

As auscultation is also comparative method, use the pattern suggested for comparative percussion, moving stethoscope from one side to the other and comparing symmetrical areas of the lungs. Listen to at least one full breath in each location.

Listen to the breath sounds in supra-, infraclavicular regions, and them move stethoscope downward. In the left 2nd and 3rd interspaces place stethoscope more laterally, as compared with percussion, in order to round the heart (Fig. 1).

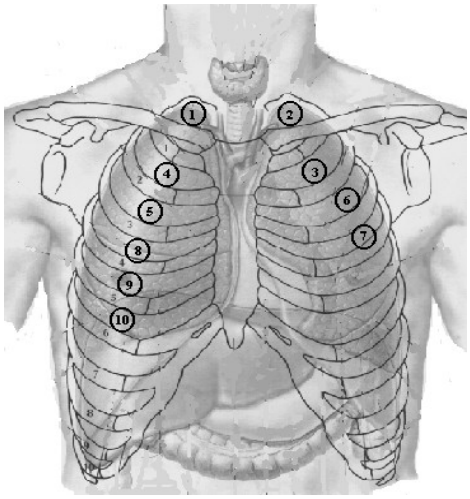


Fig. 1. Auscultation of the lungs. Anterior view.

The lungs are then auscultated in the axillary regions with the patient's hands on the back of the head (Fig. 2).

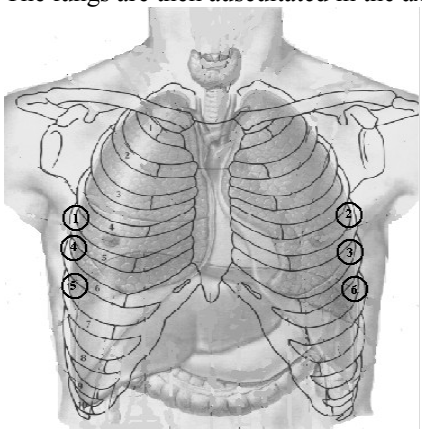


Fig. 2. Auscultation of the lungs in axillary regions.

Listen to the breath sounds posteriorly in supra-, inter-, and infrascapular regions (Fig. 3). Ask the patient to cross his arms on the chest to move scapular from the spine.

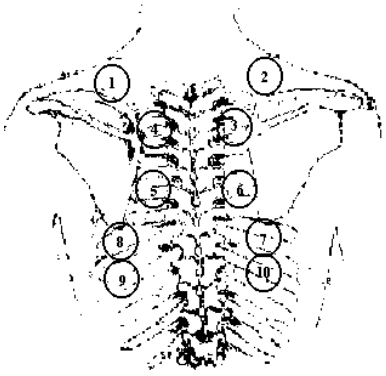


Fig. 3. Auscultations of the lungs. Posterior view.

Two types of sound can be heard coming from the lungs: the main respiratory sounds (breath sounds) and adventitious (added) sounds (Tab. 1.). Breath sounds may be normal or abnormal, added sounds are always abnormal.

Tab. 1. Lungs sounds.

Lung sounds	
Main respiratory (breath) sounds	**Adventitious** (added) sounds
▪ vesicular (alveolar) breath sounds ▪ bronchial (laryngotracheal) breath sounds	▪ rales ▪ crepitation ▪ pleural friction sounds

The main respiratory sounds (breath sounds) Normal breath sounds have been classified into two categories: ***vesicular*** and ***bronchial***, according to their intensity, their pitch, and the relative duration of their inspiratory and expiratory phases.

Vesicular breath sounds are soft, low pitched, and are heard through inspiration continue about one third of way through expiration (Fig. 2.35).

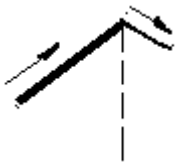


Fig. 4. Vesicular breath sound.

Breath sounds known as vesicular breathing are generated by vibration of the alveolar walls due to airflow in inspiration. A long soft (blowing) noise gradually increases and is heard through inspiration. Alveolar walls still vibrate during initial stage of expiration to give shorter expiratory sound during about one third of the expiration phase. Vesicular breathing is also therefore called – *alveolar breathing*.

Vesicular breath sounds are heard normally over most of both lungs. It should be remembered however that intensity of vesicular breathing is differ over healthy lungs (Tab. 2).

Tab. 2.. Physiological difference of the vesicular breath sounds.

Intensity	Location	Cause

More loud	below the 2nd rib, laterally of the parasternal line; axillary regions; below scapular angle	Largest masses of the pulmonary tissue
Longer and louder	over the right lung as compared with left one	Better conduction by the right main bronchus, which is shorter and wider
Less loud	lung apices; lowermost parts of the lungs	Smallest masses of the pulmonary tissue

Vesicular breath sounds can vary for both physiological and pathological causes.

Physiological changes of the vesicular breathing always involve both part of the chest, and breath sounds are equally changes at the symmetrical points of the chest (Tab. 3).

Tab. 3. Physiological changes of the vesicular breath sounds.

Decreased vesicular breathing	**Increased** vesicular breathing
Thick chest wall: ▪ excessively developed muscles or ▪ subcutaneous fat	Thin chest wall: ▪ underdeveloped muscles or ▪ subcutaneous fat ▪ in children (good elasticity of the alveoli). This type of breathing is called '*puerile'* (L *puer* – child) ▪ during exercise

Pathologic changes of the vesicular breathing can be a result of following causes:

1. *abnormal generation of breath sounds*, which depend on amount of intact alveoli, properties of their walls, and amount of air contained in them;
2. *abnormal transmission of the breath sounds* from the vibrating elastic elements of the pulmonary tissue to the surface of the chest.

Abnormalities in vesicular breath sounds may be unilateral, bilateral, or only over a limited area of the lung. Vesicular breathing can be decreased or inaudible, and increased (Fig. 5).

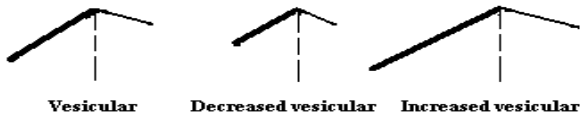


Fig. 5. Vesicular breath sounds and their changes.

Pathologically decreased vesicular breathing observes in:

I. abnormal generation of breath sounds occurs in:
- *pulmonary emphysema*, when the number of the alveoli significantly diminished. The remaining alveoli are no longer elastic, their walls become incapable of quick distension, and do not give sufficiently strong vibration;
- *initial stage of acute lobar pneumonia* due to inflammation and swelling of alveolar walls and decreased their vibrations. Vesicular breath sounds becomes *inaudible* during the *second stage of acute pneumonia*, when alveoli of affected lobe are filled with effusion;
- *obstructive atelectasis*, when airflow is decreased (over atelectasis zone). In complete obstruction breath sounds are inaudible;
- *compressive atelectasis,* when alveoli are compressed, and airflow in them is decreased;
- *inflammation of the respiratory muscles, intercostals nerves, rib fracture, muscular weakness* as a result of marked weak inspiration.

II. abnormal transmission of breath sounds results from:
- thickening of the pleural layers;
- pleural effusion;
- pneumothorax.

Pathologically increased vesicular breathing occurs when air flows at increased speed through narrowed airways (inflammatory edema of the mucosa, bronchospasm) in bronchitis and bronchial asthma. This increase in speed increases turbulence, the amount of noise made, and expiration become louder and longer.

Deeper vesicular breathing when inspiration and expiration are intensified is called **harsh**. This type of increased vesicular breathing can observe in bronchitis as a result of marked and nonuniform narrowing of small bronchi and bronchioles due to inflammatory edema of their mucosa.

Interrupted or cogwheel respiration is characterized by short jerky inspiratory efforts interrupted by short pauses between them (Fig. 6).

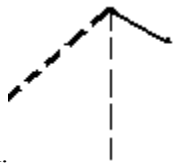


Fig. 6. Interrupted or cogwheel respiration.

Such type of respiration can be observed in non-uniform contraction of the respiratory muscles, when you listen patient in cold room, in nervous trembling, and sometimes in children during crying. Cogwheel respiration over limited area indicates difficult airflow from small bronchi to the alveoli, and also uneven unfolding of the alveoli. Interrupted breathing indicates pathology in fine bronchi and is more frequently heard over lungs apices during their tubercular infiltration.

Bronchial breath sounds are loud, harsh, high in pitch, and expiratory sound last longer than inspiratory one (Fig. 7).

Fig. 7. Bronchial breath sound.

Bronchial breath sounds are generated by turbulent airflow in the larynx and the trachea when air passes through the vocal slit. Since the vocal slit is narrower during expiration, expiratory sounds are louder, harsher, and longer. This type of breath sounds is also called *laryngotracheal*.

Bronchial breathing is heard normally over the larynx, the trachea in the neck, and at the site of projection of the tracheal bifurcation (anteriorly over manubrium, and posteriorly in the interscapular region at the level of T3 and T4 spinous processes) (Fig. 8).

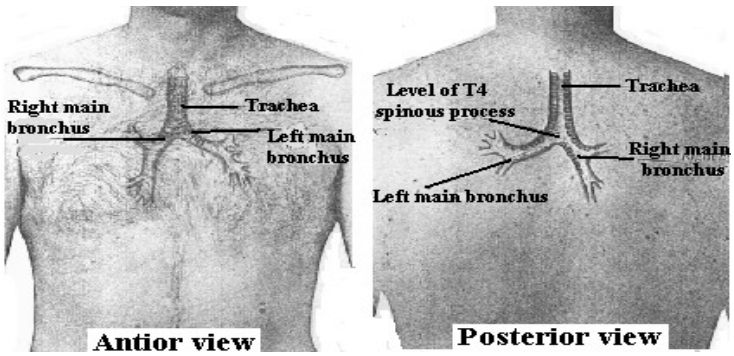


Fig. 8. Trachea and main bronchi projection on the chest.

Bronchial breath sounds are inaudible over the lungs because bronchi are covered by air-containing 'pillow' of the pulmonary tissue.

If bronchial breathing is heard over the lungs, suspect that air-filled lung has been replaced by fluid-filled or solid lung tissue, which conducts sounds better. This is so-called pathological bronchial breathing.

Pathological bronchial breathing is observed in ***consolidation of the pulmonary tissue*** in:

- *acute lobar pneumonia, tuberculosis* (when alveoli are filled with effusion);
- *lung infarction* (when the alveoli are filled with blood);
- *lung tumor* (airiness tissue);
- *compressive atelectasis* (when alveoli are compressed completely by pleural air or fluid);
- *pneumosclerosis, carnification of the lung lobe* (airless connective tissue replace airiness lung tissue);

in formation of an ***empty cavity*** in the lung communicated with a large bronchus:

- *pulmonary abscess;*
- *cavernous tuberculosis;*
- *disintegrated tumor;*
- *disintegrated lung infarction*;
- seldom *opened echinococous*.

Solid pulmonary tissue round the cavity transmits the breath sounds better, and the sounds are intensified in the resonant cavity.

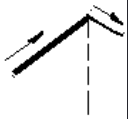
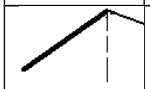
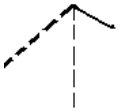
Amphoric respiration is heard in the presence of a large smooth-wall cavity (not less than 5-6 cm in diameter) communicated with a large bronchus. A strong resonance causes additional high overtones, which alter the main tone of the bronchial breath sounds. Blowing over the mouth of an empty glass or clay jar can produce such sounds. This altered bronchial breathing is therefore called amphoric (GK *amphoreus* jar).

Bronchovesicular or mixed breathing is intermediate in intensity and pitch, inspiratory and expiratory sounds are about equal (inspiratory sounds is characteristic of vesicular breathing, expiratory of bronchial breathing) (Fig. 9).

Fig. 9. Bronchovesicular breathing.

Such type of breath sounds are heard when solid lung tissue locates deep or far from one another. The characteristics of the main respiratory sounds are summarized in the Tab. 4.

Tab. 4. The characteristics of the main respiratory sounds

Sound	Duration	Intensity of the expiratory sound	Pitch of the expiratory sound	Example location	Pathologic example
 Vesicular	Inspiratory sounds last longer than expiratory one	Soft	Low	Over most of both lungs	---
 Decreased vesicular	Inspiratory and expiratory sounds last shorter	Softer	Low	None normally	Emphysema, acute pneumonia, obstructive atelectasis, muscular weakness, hydrothorax, pneumothorax
 Increased vesicular	Inspiratory and expiratory sounds last longer	Louder	Low	None normally	Bronchial asthma, bronchitis
 Cogwheel	Interrupted inspiration	Relatively soft	Relatively low	Cold room, nervous trembling	Diseases of the respiratory muscles, pathology in fine bronchi (tuberculosis)
 Bronchial	Expiratory sounds last longer than inspiratory one	Loud	Relatively high	Over the larynx, the trachea, manub-rium, interscа-pular region (at the level of T3, T4)	Over the lungs in consolidation of the pulmonary tissue (acute lobar pneumonia, tuberculosis, lung infarction, compressive atelectasis), cavity in the lungs (abscess, caverna)

 Broncho-vesicular	Inspiratory sounds and expiratory sounds are about equal	Intermediate	Interme-diate		Deep location of the solid lung tissue

Tests

1. Which respiratory sounds are the main:
A. Harsh respiration
B. Dry rales
C. Crepitation
D. Moist rales
E. Pleural friction sound

2. Indicate the site of vesicular breathing origination:
A. Main bronchus
B. Vocal slit
C. Bronchioles
D. Alveoli
E. Pleural cavity

3. Harsh respiration is heard in:
A. Dry pleurisy
B. Pulmonary tuberculosis
C. Lung tumor
D. Acute pneumonia
E. Bronchial asthma

4. Indicate the site of dry rales origination:
A. Bronchus
B. Vocal slit
C. Cavity in the lung
D. Alveoli
E. Pleural cavity

5. Moist rales (crackles) are heard in patients with:
A. Acute lobar pneumonia (initial stage)
B. Acute lobar pneumonia (consolidation stage)
C. Bronchial asthma
D. Pulmonary edema
E. Effusive pleurisy

6. Crepitation is heard in the patients with:
A. Bronchial asthma
B. Acute bronchitis
C. Chronic bronchitis
D. Acute lobar pneumonia (consolidation stage)
E. Acute lobar pneumonia (initial stage)

7. Pleural friction sound is heard in patients with:
A. Dry pleurisy
B. Acute bronchitis
C. Acute lobar pneumonia (initial stage)
D. Bronchial asthma
E. Pulmonary emphysema

10. In the right subscapular and axillary area the voice resonance is increased, the percussion sound is dull, there is bronchial respiration. What diagnosis can be suggested?
A. Bronchitis
B. Exudation pleurisy
C. Bronchial asthma
D. Pulmonary emphysema
E. **Acute lobar pneumonia (consolidation stage)**

Voice resonance is weak over the lungs, band-box sound in percussion, decreased vesicular respiration. What diagnosis can be suggested?
A. Exudation pleurisy
B. Bronchitis
C. Pneumonia
D. **Pulmonary emphysema**
E. Lung cancer

The patient has a constant fever. On the left side along all lines from the 4th interspace downward all lines there is intermediate percussion sound, decreased vesicular respiration. What diagnosis can be suggested?
A. **Initial stage of lobar pneumonia**
B. Exudation pleurisy
C. Lung cancer
D. Bronchitis
E. Pulmonary emphysema

11. On the right over the lungs there is weak voice resonance, tympanic percussion sound, the respiration is not heard. What diagnosis can be suggested?
A. Pulmonary emphysema
B. **Pneumothorax**
C. Bronchial asthma
D. Obstructive bronchitis
E. Exudation pleurisy

12. There is clear percussion sound and harsh respiration over the lungs is heard. What diagnosis can be suggested?
A. Bronchial asthma
B. Pulmonary emphysema
C. **Bronchitis**
D. Pneumonia
E. Lung cancer

13. The patient's chest is barrel-shaped, band-box percussion sound and decreased vesicular respiration is heard. What diagnosis can be suggested?
A. Acute lobar pneumonia (initial stage)
B. Acute lobar pneumonia (resolution stage)
C. Bronchitis
D. **Pulmonary emphysema**
E. Obstructive bronchitis

14. On the left over the chest there is dull percussion sound along the midaxillary line from the 4th interspace, along the scapular line from the 6th interspace along the vertebral line from the 7th interspace downwards. It transforms to dulness, over the area of dullness the respiration is not heard. What diagnosis can be suggested?
A. Lung carnification
B. Pneumonia
C. Lung abscess
D. Lung cancer
E. **Exudation pleurisy**

15. The patient complains of absence of appetite, loss of weight. The body temperature is subfebrile. In the right subclavicular area there is tympanic sound and amphoric respiration. What diagnosis can be suggested?
A. Pneumonia
B. **Cavity**
C. Bronchial asthma
D. Lung cancer
E. Exudation pleurisy

16. The right hemithorax delays in respiration: on breathing in the right subclavicular area there is tympanic sound and amphoric respiration. What diagnosis can be suggested?
A. Bronchitis
B. Exudation pleurisy
C. Pneumothorax
D. Pulmonary emphysema
E. Cavity in the lung

17. The patient's chest is normosthenic. The respiratory motions are symmetrical. The voice resonance is unchanged. The percussion sound is respiratory. The respiration is rough. What diagnosis can be suggested?
A. Bronchitis
B. Bronchial asthma
C. Pneumonia
D. Lung cancer
E. Lung abscess

Keys: 1A, 2D, 3E, 4A, 5A, 6E, 7A, 8E, 9D, 10A, 11B, 12C, 13D, 14E, 15B, 16E, 17A

Methodical instructions

RESPIRATORY SYSTEM EXAMINATION. LUNGS PERCUSSION. TECHNIQUE OF COMPARATIVE AND TOPOGRAPHIC PERCUSSION.

Methodical instructions for students

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