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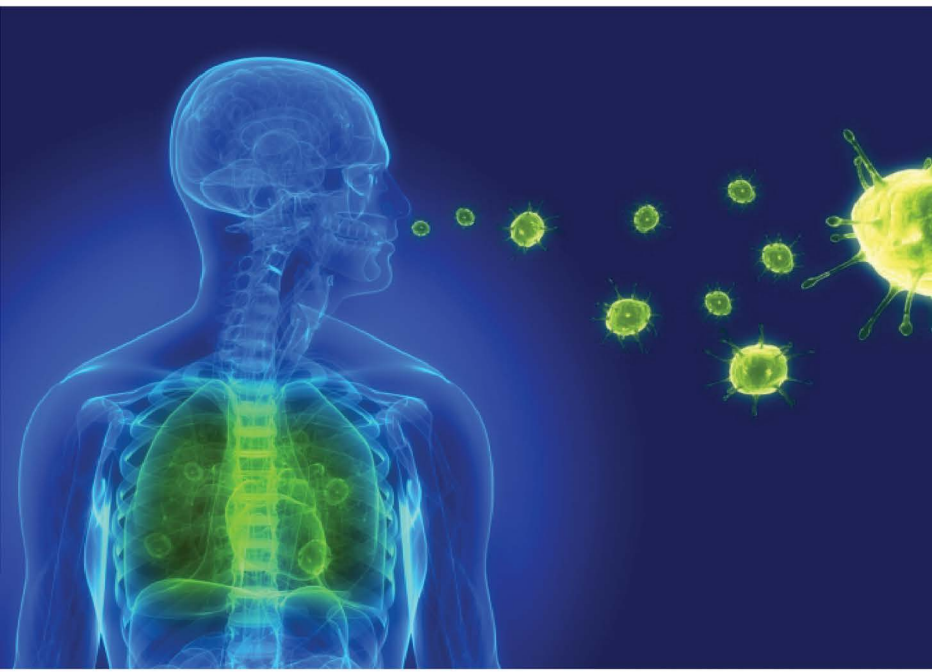
# Clinical Pearls in Pulmonology



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Chapter

# 4 Auscultation of the Chest

**1. How are the normal breath sounds produced?**

Breath sounds are produced by the vibration of vocal cords due to the turbulent flow of air through the larynx and they are high pitched at the sites of their origin. High pitched sounds are perceived as loud sounds. These high pitched sounds are then transmitted along the trachea and bronchi to the chest wall and during this process they are filtered and muffled by the surrounding air- filled lung tissue (Fig. 4.1).

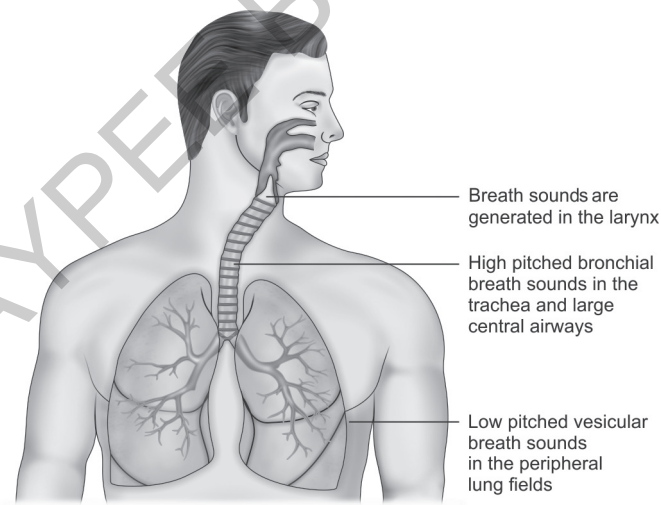


**Fig. 4.1:** Breath sounds in various locations

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Thus, the high pitched sounds generated in the larynx are converted to low pitched sounds and these low pitched sounds are heard over most regions of the chest wall during auscultation. The normal breath sounds are broadly classified into bronchial and vesicular sounds.

**2. What are vesicular breath sounds?**

Vesicular sounds are soft, breezy, low pitched sounds with a **rustling** quality that are normally heard all over the peripheral lung fields. They are prominent during inspiration and early part of expiration, and there is no silent gap in between the two phases of respiration (Fig. 4.2).



**Fig. 4.2:** Vesicular breath sound

**3. What are the variations that can occur to vesicular breath sounds?**

Some disease states can alter the quality of vesicular breath sounds. Vesicular breath sounds may be diminished in intensity in the following situations.

- Conditions causing under-expansion of lungs due to restricted chest wall movement (like chest pain, respiratory muscle weakness, ascites, large abdominal mass, etc.)
- In conditions producing separation of the pleural surfaces by fluid or air (like pleural effusion or pneumothorax)

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- In case of pleural thickening due to fibrosis or metastatic infiltrating tumors
- In persons with very thick chest wall.

Vesicular breath sounds with prolonged expiration may be heard in obstructive airway disorders like bronchial asthma and COPD.

**4. What are bronchial breath sounds?**

Bronchial sounds are loud, harsh, usually high pitched sounds heard normally over the trachea, upper sternum and paraspinal areas upto the second thoracic vertebrae. They are more prominent during expiration and the duration of expiration is equal to or more than that of inspiration. There is a silent gap in between the two phases of respiration (Fig. 4.3 and Table 4.1).



**Fig. 4.3:** Bronchial breath sound

**Table 4.1:** Difference between vesicular and bronchial breath sound

| Vesicular breath sound | Bronchial breath sound |
|---|---|
| Soft, breezy and low-pitched | Loud, harsh and high-pitched |
| Prominent during inspiration | Prominent during expiration |
| No gap between the two phases | Silent gap between the two phases |
| Heard over peripheral lung fields | Heard over larger airways |

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**5. What are the types of bronchial breath sounds?**

Bronchial breath sounds are considered abnormal when they are heard at locations where vesicular breath sounds are usually heard. There are three types of bronchial breath sounds. They are the following (Box 4.1):

**Box 4.1:** Types of bronchial breath sounds

- Tubular
- Cavernous
- Amphoric

**6. What is tubular bronchial breath sound?**

Tubular bronchial breath sound is the most common type of bronchial breath sound. It is heard in situations where there is conduction of breath sounds directly from the peripheral bronchi to the overlying chest wall through an interposed solidified lung tissue without the normal filteration or modification by air-filled alveoli.

Such situations occur when consolidated or fibrosed lung tissue or a mass lesion or an area of compression atelectasis (above the level of a massive pleural effusion) is interposed in between a large bronchus and the chest wall. Then the tubular bronchial breath sounds generated in the bronchus are conducted directly to the chest wall without filteration.

**7. What is D'Espine's sign?**

Sometimes large posterior mediastinal masses may transmit the bronchial breath sounds generated in the large central airways directly to the posterior chest wall. Hence, tubular bronchial breath sounds may be heard in the interscapular area below the second thoracic vertebrae. This sign is called as the D' Espine's sign (Box 4.2).

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**Box 4.2:** Common tumors of the posterior mediastinum

- Neurogenic tumors (Neurofibroma, ganglioneuroma, etc.)
- Lymphatic tumors
- Vascular lesions

**8. What is cavernous bronchial breath sound?**

Cavernous breath sound is a relatively low pitched bronchial breath sound that is heard over a superficial collapsible cavity (more than 2 cm in diameter) with a communicating patent bronchus. Usually such cavities are surrounded by either consolidated or fibrosed lung tissue.

The high pitched tubular bronchial breath sound generated in the bronchus harmonicates within the cavity and is converted to low pitched cavernous bronchial breath sound. This low pitched sound is then conducted to the chestwall by the relatively airless consolidated or fibrosed lung tissue surrounding the cavity (Box 4.3).

**Box 4.3:** Auscultatory triad of a cavity

- Cavernous bronchial breath sounds
- Post-tussive suction sound
- Increased vocal resonance (whispering pectoriloquy)

**9. What is amphoric bronchial breath sound?**

Amphoric bronchial breath sound is another type of low pitched bronchial breath sound which has high-pitched overtones. It is heard in the case of a very large cavity communicating with a patent bronchus or in cases with bronchopleural fistula. The mechanism of production is the same as that of cavernous bronchial breath sound. However, in this case, some of the reflected sound waves from the walls of the large cavity are high pitched.

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**10. What is a bronchopleural fistula?**

A bronchopleural fistula is a communication between the pleural space and the bronchial tree. It is a rare, but serious complication associated with several pulmonary conditions. In the setting of a spontaneous or non-spontaneous pneumothorax, it is consistent with prolonged air leak. Current American College of Chest Physicians (ACCP) guidelines recommend that, if the air leak persists over 4 days in a case of pneumothorax, then the patient should be considered for surgery to close the air leak.

**11. Which are the common adventitious sounds heard during examination of the respiratory system?**

The adventitious sounds are broadly classified into continuous and discontinuous sounds. The common continuous sounds are stridor and wheeze (low-pitched wheezes are sometimes referred to as rhonchi). The common discontinuous sounds are the crackle and pleural rub (Table 4.2).

**Table 4.2:** Adventitious sounds

| Continuous sounds | Discontinuous sounds |
|---|---|
| • Stridor<br>• Wheeze | • Crackle<br>• Pleural rub |

**12. What is meant by stridor?**

Stridor is a high-pitched sound that is produced due to the narrowing or obstruction of the large upper airways i.e. the larynx and the trachea. Stridor is almost always inspiratory (*Ref: Fishman's Pulmonary Diseases and Disorders, 4th edition, Pg 846)*. It is best heard over the neck.

The presence of stridor indicates upper airway obstruction and the relief of this obstruction is often

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a matter of great urgency. Common causes of stridor are a foreign body in the upper intrathoracic airway or esophagus, an acquired lesion of the airway (e.g. carcinoma in adults), or a congenital lesion in children.

**13. What is Pickwickian syndrome?**

An important cause of stridor in obese people is the obesity hypoventilation syndrome (OHS), or the Pickwickian syndrome. OHS is defined as the **triad** of morbid obesity, day time hypoventilation and sleep disordered breathing in the absence of an alternative neuromuscular, mechanical or metabolic explanation for hypoventilation. Stridor occurs due to the inspiratory pharyngeal collapse in these people. Patients with obesity hypoventilation syndrome often can be confused with patients with COPD since both of these patients manifest daytime hypercapnia. However, patients with COPD have an obstructive pattern on their pulmonary function studies, whereas patients with OHS usually have a restrictive pattern on their pulmonary function studies. In addition, patients with COPD are usually not morbidly obese.

**14. What are wheezes and how are they produced?**

The American Thoracic Society Committee on pulmonary nomenclature define wheezes as continuous sounds with a dominant frequency of usually 400 Hz or more. There are also lower pitched wheezes with a dominant frequency of 200 Hz or less (these lower pitched sounds were previously referred to as rhonchi). Wheezes are usually more prominent on expiration because the airways tend to become narrower during expiration.

Wheezes are produced by the fluttering or oscillation of adjacent airway walls. At the sites of airway obstruction, airflow velocity reaches a critical value called as the

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flutter velocity. When airflow attains this critical velocity, the adjacent airway walls begin to flutter or oscillate like the strings of a guitar. This generates the musical sound (Fig. 4.4).

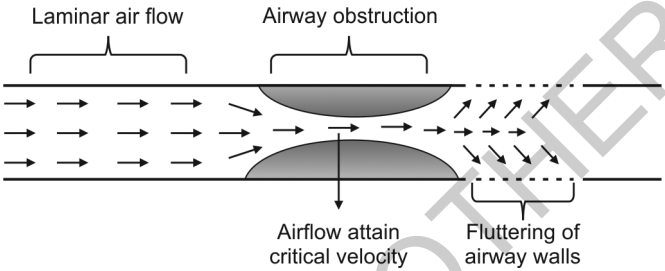


**Fig. 4.4:** Mechanism of production of wheeze

**15. What are the different types of wheeze?**

Wheezes are classified as monophonic if the sounds are of the same pitch. Monophonic wheeze suggests localized obstruction of one airway. Wheezes are classified as polyphonic if the sounds are of varying pitch or frequency. Polyphonic wheeze suggests obstruction of airways at multiple sites (Table 4.3).

**Table 4.3:** Classification of wheeze

| Monophonic wheeze | Polyphonic wheeze |
|---|---|
| Foreign body inhalation | Asthma |
| Bronchial tumor | COPD |

**16. What are crackles (rales, crepitations)?**

Crackles are discontinuous adventitious breath sounds resembling miniature explosions. They are heard more often during inspiration than during expiration. They may be fine or coarse depending on the mechanism

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of production and their timing is of great clinical importance.

- Early inspiratory crackles suggest disease of the small airways
- Late or pan-inspiratory crackles suggest disease of the alveoli.

**17. How are fine crackles produced?**

In conditions like interstitial fibrosis and in interstitial stage of pulmonary edema, the peripheral airways in the basal territories of the lung remain closed towards the end of expiration. This is due to the following factors:

- Increased elastic recoil of the airways because of the loss of elastic fibers in the interstitium due to interstitial fibrosis
- Due to the compression of the airways by the weight of the overlying fluid filled interstitium in conditions like pulmonary edema.

The air within the alveoli supplied by these closed peripheral airways is considerably below atmospheric pressure. Towards late inspiration, when the intrabronchial pressure increases, these closed peripheral airways eventually reopen. This results in a sudden equalization of pressures across the previously closed parts of these airways. This sudden equalization of pressure produces an explosive sound which is called the fine crackle.

Eventhough crackles are usually associated with diseases of the lung, they can also occur in normal healthy people. Fine late inspiratory crackles may occur in healthy people in the dependent lung regions (i.e. over the anterior lung bases) after prolonged periods of recumbency. These "normal" or "physiological" fine crackles usually resolve after taking few deep inspirations (Figs 4.5 and 4.6).

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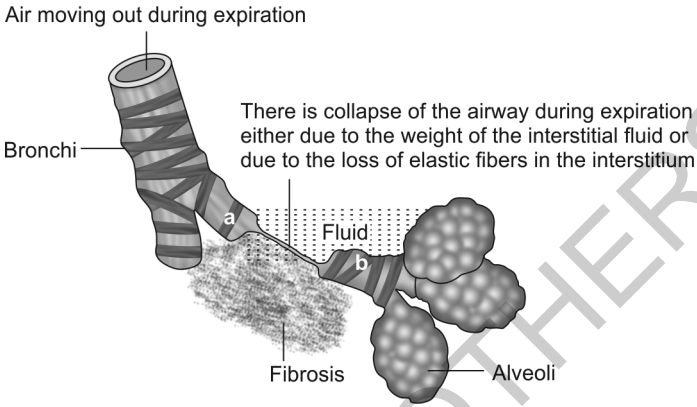


**Fig. 4.5:** Mechanism of generation of fine crackle—step 1

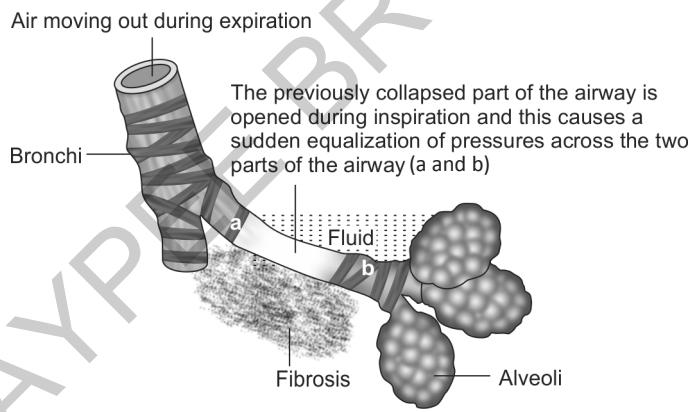


**Fig. 4.6 :** Mechanism of generation of fine crackle—step 2

**18. What is the effect of gravity on fine crackle?**

The closure of peripheral airways in the basal territories of the lung in conditions like interstitial edema is mainly due to compression by the weight of the overlying fluid

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filled lung. Shifting this fluid by turning a recumbent patient from one side to another can remove this weight and thereby prevent the closure of these peripheral airways. This can result in sudden or gradual disappearance of fine crackles. Hence, fine crackles are said to be gravity dependant and they are not affected by maneuvers like coughing.

**19. What are Velcro crackles?**

Velcro sounding crackles are a type of fine crackles heard in interstitial fibrosis. They have a distinctive character and are also described as "close to the ear" or "cellophane" crackles. Their sound is similar to the sound of hair rubbed between the fingers. In mild or early stages of interstitial lung disease, they are late inspiratory and are best heard at the basal areas of the lung, with the patient sitting upright. As the disease progresses, these fine crackles may become pan-inspiratory and may extend to higher levels above the lung bases (Box 4.4).

**Box 4.4:** Clinical features of interstitial lung disease (ILD)

- History of progressive dyspnea
- Central cyanosis
- Clubbing
- Diminished chest movements
- Impaired chest percussion note
- Velcro crackles

**20. How are coarse crackles produced?**

Coarse crackles are produced by the passage of boluses of air through an intermittently obstructed airway (usually with thick viscid mucus). The passage of each bolus of air leads to sudden equalization of pressures on either side of the occluded part of the airway. This in turn produces an explosive sound which is the coarse crackle (Fig. 4.7).

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# Clinical Pearls in Pulmonology

***Salient Features***

- A pocket-sized quick reference guide
- Presents the essentials of pulmonology in a simple and compact style
- Provides a concise collection of vital information on the signs and symptoms of lung diseases
- Includes more than 200 questions and answers on clinical aspects of pulmonology and enhanced by illustrations, well-charted out figures and tables
- Divided into 10 chapters, covering history taking, general examination, examination of the respiratory system, common lung diseases and radiology
- Serves as an ideal source material for undergraduate and postgraduate medical students.

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