

Compliance of lungs, Respiratory Work, and Pneumothorax.

Mechanism of breathing

Muscle contraction and relaxation function to bring air in and out of the respiratory system.

During **normal breathing**, contraction of the diaphragm and external intercostals increases the volume of the thoracic cavity, which decreases the intrathoracic and intrapleural pressures and works in inspiration. Relaxation has the opposite effect in expiration.

During **exercise and respiratory distress**, other muscles are also used – scalene and sternocleidomastoid (inspiration), internal intercostal and abdominal (expiration).

Pressure and volume changes correspond to inspiration and expiration (see graph (<https://qph.fs.quoracdn.net/main-qimg-c024185d02c6645fc5724bb68046f46e.webp>)).

Lung compliance

Compliance is a description of the ability of the lungs and chest wall to distend. This is essential for exhalation. It is possible due to

- elasticity of lung tissue
 - Elastic fibers
 - Alveolar surface tension
- non-elastic resistance
 - friction of parietal and visceral pleura
 - airway resistance

Compliance inherently decreases with increasing stiffness, but also depends on physical circumstances:

$$C = V/P$$

For Compliance C (mL/mm Hg), Volume V (mL), Pressure P (mm Hg)

Plotting V vs P (<https://www.researchgate.net/profile/Jonathan-Burdon/publication/7510691/figure/fig5/AS:624513167400967@1525906950764/Pressure-volume-relationships-as-a-measure-of-compliance-1-elastance-usually-expressed.png>) can give the slope (a measure of compliance).

Inspiration and expiration follow different pathways on this plot, since it takes work to overcome surface tension during inspiration but not during expiration.

Respiratory work includes the work needed to overcome

- Elastic forces in lungs
- Viscosity of surfactant
- Airway resistance

Pneumothorax

If air is introduced into the intrapleural space, the pressure there will increase to the level of the surroundings. The lungs will then collapse, and the chest wall will go outward.

Etiological classifications

- traumatic: injury to chest wall, ribs, esophagus, or bronchi
- spontaneous
- primary idiopathic: may occur in tall, healthy, male patients with family history of pneumothorax
- secondary: consequence of pulmonary diseases (COPD or cystic fibrosis)
- iatrogenic pneumothorax: consequence of invasive examinations, ex: transparietal aspiration biopsy, subclavian vein catheterization, or mechanical ventilation with positive pressure.
- artificially induced: during thoracoscopy

Structural classifications

- open: continuous air exchange due to open perforation
- closed: perforation closes and prevents further exchange
- valvular: surrounding tissue functions as a valve - air flows in during inspiration but out during expiration

References

