MASTER OF PHYSIOTHERAPY

Basic Sciences

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Compliance of Thoracic Cage

Definition:

Compliance: The compliance of a system is defined as the change in volume that occurs per unit change in the pressure of the system.

Pulmonary compliance:

- A measure of the lung expandability, is important in ideal respiratory system function. It refers to the ability of the lungs to stretch and expand. Lung compliance can be calculated by dividing volume by pressure (C = V/P).
- Pulmonary compliance (C) is the total compliance of both lungs, measuring the extent to which the lungs will expand (change in volume of lungs) for each unit increase in the trans-pulmonary pressure (when enough time is allowed for the system to reach equilibrium).

  Lung Compliance (C) = Change in Lung Volume (V) / Change in Transpulmonary Pressure {Alveolar Pressure (Palv) – Pleural Pressure (Ppl)}.

Lung compliance is inversely proportional to elastance. This elastic resistance is both due to the elastic property of lung tissue or parenchyma and the surface elastic force. Any changes occurring to these forces could lead to changes in compliance.

Importance

It is one of the most important concepts underpinning mechanical ventilation used to manage patient respiration in the operating room (OR) or intensive care unit (ICU) environment.
Normally the total compliance of both lungs in an adult is about 200 ml/ cm H2O.
Physiotherapists depends on this concept to understand some pulmonary pathologies and help guide therapy and adjust ventilator pressure and volume settings.
Compliance determines 65% of the work of breathing. If the lung has low compliance, it requires more work from breathing muscles to inflate the lungs.
In specific pathologies, continuous monitoring of the lung compliance curve is useful to understand the progression of the condition and to decide on therapeutic settings needed for ventilator management.

Types of Compliance:

Static Compliance:

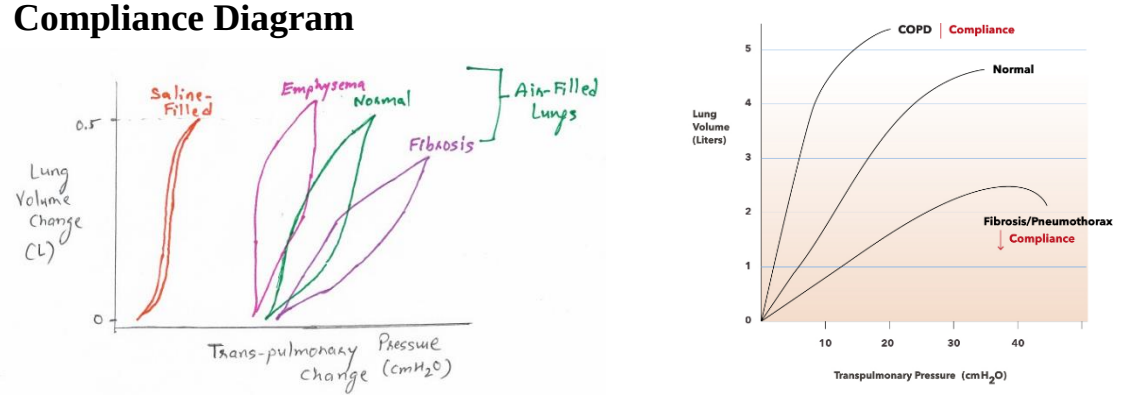
It represents pulmonary compliance at a given fixed volume when there is no airflow, and muscles are relaxed.
This situation takes place when transpulmonary pressure equals the elastic recoil pressure of the lungs. It only measures the elastic resistance.
Its measurement uses a simple water manometer, but electrical transducers are now more commonly used.

In the conscious individual, it is difficult to achieve complete certainty of respiratory muscle relaxation. But the compliance measurement is considered valid since the static pressure difference is unaffected by any muscle activity.
In cases of a paralyzed individual as in the operating theatre, it is straightforward to measure static compliance using recordings captured through electrical transducers. Therapeutically, it serves to select the ideal level of positive end-expiratory pressure, which is calculated based on the following formula:
Cstat = V / (Pplat – PEEP)
Pplat = Plateau pressure, PEEP = Positive End Expiratory Pressure

Dynamic Compliance:

It is the continuous measurement of pulmonary compliance calculated at each point representing schematic changes during rhythmic breathing.
It monitors both elastic and airway resistance.
Airway resistance depends on the air viscosity, density, and length, and radius of airways.
Except for the radius of the airway, all other variables are relatively constant.
Thus, airway resistance can undergo physiologic alteration by changes in the radius of the airway bronchus.

Compliance Diagram



When different readings of the lung volume are taken at specific measured pressure points and then plotted on a diagram, a pressure-volume curve representing both elastic and airway resistance properties of the lung is obtained.
The two meeting points are end-inspiratory and end-expiratory points, and the line connecting them provides the measurement of dynamic compliance of the lungs.
The area falling between this line and both the curves represents the excess work required to overcome the airway resistance during inspiration and expiration. This curve is also called the Hysteresis curve.
You can see that the lung is not a perfect elastic structure. The pressure required to inflate the lungs is higher than the pressure necessary to deflate them.

Factors Affecting Pulmonary Compliance

Elastic Property of the Lung Tissue
Surface Tension Elastic Force
Surfactant
Lung Volume
Age

Clinical Pathology

Certain pulmonary diseases can influence changes in lung compliance.
Some pathologies that can increase or decrease lung compliance.
Emphysema or COPD
Pulmonary Fibrosis
Newborn Respiratory Distress Syndrome
Atelectasis /ARDS