Respiratory compliance:

Definition

Lung compliance is defined as the change in lung volume per unit change in the transmural pressure gradient (between the alveolus and the pleural space) and is typically measured in liters per centimeter of H2O. Therefore it is also the slope of the line that results from plotting volume against pressure.

Compliance can be measured for the lung, the chest wall, or the lung and chest wall as a unit (the respiratory system). The normal value for either lung or chest wall compliance is 0.2 L/cm H2O. The typical compliance for the respiratory system as a whole is 0.1 L/cm H2O. Compliance is dependent both upon lung volume and time and can thus be described as both a static and dynamic measurement.

$C = \Delta V \; \Delta P$

ΔV = the change in volume in liters
ΔP = the change in pressure in cm H_2O C = compliance in L/cm H_2O

There are two different types of compliance: static and dynamic

Static compliance is determined by measuring the pressure difference when a known volume of air is inhaled and held constant starting from FRC. **Static compliance is a measured during plateau (rather than peak inspiratory) pressure.** PEEP should be subtracted from plateau inspiratory pressure in making this calculation.

In a ventilated patient, compliance can be measured by dividing the delivered tidal volume by the [plateau pressure minus the total peep].

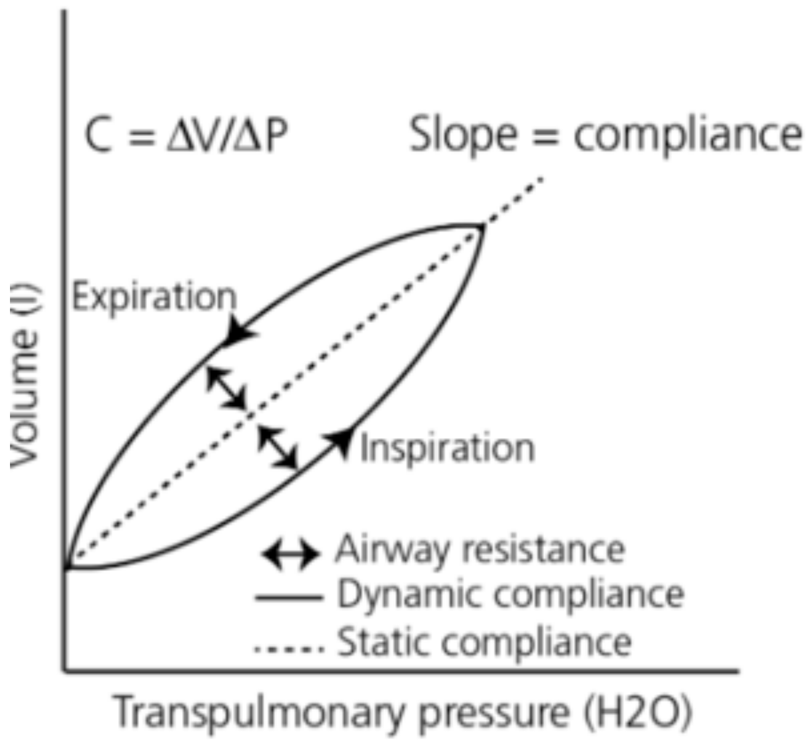
Compliance = V_T (del) / P_{PLAT} - $PEEP_{TOT}$

Dynamic compliance is measured during normal tidal breathing and is derived from the slope of the line connecting the end-inspiratory and end-expiratory points of the pressure-volume loop. The difference between static and dynamic respiratory compliance reflects the time dependency of the system. Because the pressure-volume curve (see below) is not linear during inspiration and expiration due to changes in the lung tissue, **Dynamic compliance varies and is a calculated with a measurement of tidal volume at a given intrathoracic pressure during which there is airflow through the lungs at any point during inspiration or expiration.**

Lung compliance will change with age, body position, and various pathological entities. Normal adult lung compliance ranges from 0.1 to 0.4 L/cm H_20. The chest wall has elastic properties just as the lung does, based on the configuration of its bones and musculature. Normal compliance of the chest wall is approximately the same as that of the lungs, 0.2 L/cm H_20.

The typical compliance for the respiratory system as a whole is 0.1 L/cm H2O.

Another way to determine chest wall compliance is graphically using a pressure volume curve. The slope of the line is equal to the lung compliance. During inhalation, lung volume at any given pressure is less than the lung volume at that same pressure during exhalation. The difference between the pressure-volume curves of inhalation and exhalation can be described as lung hysteresis. Is caused by a variety of factors, including: 1. Change in surfactant activity 2. Stress relaxation 3. Gas redistribution between slow-filling and fast-filling alveoli 4. Alveolar recruitment as closed alveoli open 5. Displacement of pulmonary blood volume



Factors That Affect Respiratory Compliance :

Factors that increase FRC also increase pulmonary compliance. Emphysema, for example, increases compliance as a result of loss of the normal elastic recoil of the lungs. As another example, men have approximately 10% higher FRC and subsequently better compliance than women because men have proportionally higher lean muscle mass.

Alternatively, pulmonary compliance is reduced by factors that decrease FRC.

1. Ascites, obesity, pleural effusion, pericardial effusion, cardiomegaly, and general anesthesia all decrease FRC through external compression or elevation of the diaphragm.
2. Pleural, interstitial, and alveolar fibrosis will decrease FRC by decreasing the elastic properties of the lung.
3. Atelectasis, pulmonary artery obstruction, and pneumonia decrease FRC through decreased surfactant at the alveolar/air interface.
4. Poliomyelitis, pectus excavatum, spasticity, and kyphoscoliosis decrease FRC because of restriction of the thoracic wall.
5. Skeletal muscle disorders decrease FRC because of diaphragmatic elevation.

6. Positioning and age can also affect compliance because of changes in closing capacity (CC) relative to FRC. CC is the lung volume below which small airways begin to close in the dependent lung regions. With age, CC increases at a rate that exceeds the rate of increase in FRC.
7. CC first exceeds FRC in the supine position at the age of 44 years and then in the upright position by the age of 75 years. When CC exceeds FRC, some of the dependent alveoli cannot empty before the airways leading to them close. This contributes to increased $\dot{V}/\dot{Q}$ mismatching and A-a gradient.

8. Bronchial smooth muscle tone affects pulmonary compliance through increased airway resistance and thus pressure needed to expand the lung. Bronchoconstriction may increase the time-dependent properties of compliance and reduce dynamic lung compliance more than static compliance.

Sources

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