النادي الطبي

RS

Hamza Trad

Physiology Summaries

Lecture : 3

Done by : Dana khalaf 🎀

Respiratory System

Pulmonary compliance & Airway resistance

Pressure in the pleural cavity is negative related to intra-pulmonary pressure..Why?

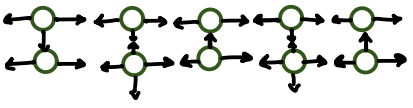
A: chest wall tends to expand ⟶ ↓ prussure by ↑ Volume

B: في عنا قوتين بتولد ضغط جوا الرئتين وبتخليه اعلى ، فبكون الضغط جوا القفص الصدري سالب بالنسبة الها

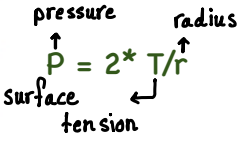
1- Elastic forces: produced by elastic fibres of the lungs ➡️ contribute by 1/3 of lung elasticity
2- Surface tension: contribute by 2/3 of lung elasticity

Above 2 forces attribute to the tendency of lungs to collapse(والقوتين هدول بسميهم elastance)

طيب .. شو يعني surface tension ؟
هلأ بأي سائل لما يكون حوليه هواء في عنا سطح فاصل بين الهواء والسائل،، وجزيئات السائل في قوى شد بينها (قوى التماسك) هاي بكون تأثيرها عالسطح لانو بالنص هاي القوى رح تلغي بعضها هيك



هلأ الجزيئات اللي عالسطح حيكون تأثيرها لتحت ... شو دخلها بال lungs ؟
احنا عنا ال alveoli مليانة هوا وفي بأطرافها سائل، هاد رح يتولد على سطحه surface tension يؤدي ل انكماش بال alveoli، وهاد ال tension بولد ضغط حسب قانون young laplace :



وهاد الضغط اسمه collapse pressure :
طيب هيك صار عنا فرق بالضغط بين lungs + pleural cavity والفرق هاد بسميه Transpulmonary pressure

ملاحظة ⬅️ اي فرق بالضغط خلال حاجز بسميه : Transmural pressure

Respiratory cycle:
Each respiratory cycle takes 4-5 seconds and consists of inspiration & expiration

تعالو نحكي عن التغيرات بكل مرحلة 👇

Respiratory System

1- Inspiration

A- pulmonary pressure (alveolar) : first it decreases, why?
To beat the collapse pressure caused by surface tension by ⬆️ radius of alveoli:
قلنا قبل انو p = 2* T/ r وبما انه رفعنا r بالتالي رح يقل ال p
Then it will ⬆️ by inflow of air to the lungs and by ⬆️ elastic recoil of the lung

B- pleural pressure: it becomes more negative and reaches its highest negativity by the end of inspiration.

لي بصير negative اكتر ؟
لانو زاد ال diameter تاع ال chest wall فزاد الحجم وحسب القانون (الحجم*الضغط) قبل =(الحجم*الضغط) بعد
ف رح يقل الضغط

C- lung volume: it will increase

2 - Expiration

A- Alveolar pressure: it will slightly increase, then it will decrease because of ⬇️ lung volume

B- pleural pressure: it will increase because of relaxation of inspiratory muscles which cause ⬇️ in chest wall volume

C- lung volume: it will decrease

NOTES⬇️

Alveolar pressure: highest value ➡️ 1 cm.H2O At the beginning of expiration
lowest value ➡️ -1 cm.H2O At the beginning of inspiration

Pleural pressure: highest value ➡️ -5 cm.H2O At the end of expiration
lowest volume ➡️ -7.5 cm.H2O At the end of inspiration

Lung volume: highest value by the end of inspiration
lowest value by the end of expiration

Respiratory System

The difference between lung volume during quite breathing is called tidal volume = 0,5 L

Transpulmonary pressure: is directly related to the elastic forces (elastance) of the lung and it reaches its maximum level by the end of inspiration.

Lung compliance

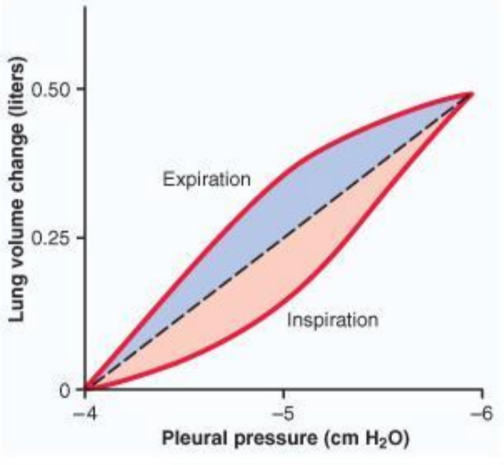
It is the stretchability of the lung or it is the volume of the lung at a given pressure

$$\text{Lung compliance} = \frac{\Delta \text{ in lung volume}}{1 \text{ cm } H_2O \text{ transpulmonary pr.}}$$

(Normal value is 200 ml of air/cm H_2O)

Lung compliance is due to elastic forces of elastic fibre's & surface tension

بالتالي اي عامل بأثر ع ال elastance رح يأثر ع lung compliance



Notes on the curve:

1- this curve represents dynamic lung compliance

2- lung compliance differs between inspiration & expiration (higher in expiration than inspiration) ➡️ this is called Hysteresis.. why ?

At the beginning of inspiration surface tension will be highest, also during inspiration Transpulmonary pressure is increasing which produce more elastic recoil opposite to the inspiratory force.

عشان السببين اللي ذكرناهم ال work بال inspiration اعلى من expiration ... طبيب مهو بال expiration في عنا elastic recoil لي ما أثر عالموضوع ؟

بال expiration ال elastic recoil بكون مع اتجاه ال expiratory force وبتضل تقل لحد ما توصل الرئة لل resting volume .

3- Elastance is inversely related to compliance

لانو حكينا العلاقة طردية بين elastance, Transpulmonary pressure بالتالي حتكون ال elastance عكسية مع compliance حسب القانون .

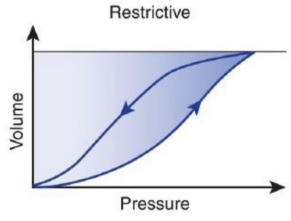
$$\text{Lung compliance} = \frac{\Delta \text{ in lung volume}}{1 \text{ cm } H_2O \text{ transpulmonary pr.}}$$

(Normal value is 200 ml of air/cm H_2O)

Respiratory System

Conditions that ⬇️ or ⬆️ compliance:

1- Restrictive lung disease: ⬇️compliance due to pressure of fibrous tissue (هاد قاسي ما بتمطا)
بالتالي رح يلزمنا ضغط اكبر عشان نوصل لنفس الجسم ف بروح ال curve بالاتجاه الأفقي



2- Emphysema: ⬆️ compliance due to destruction of elastic fibers (⬇️ elastance)
بالتالي ال chest wall رح يسحب ال lung معه ويكبرها، هلأ المشكلة هون بال expiration اكتر لانو قل ال elastic
ف بصير ال recoil بده وقت اطول، وبنميز المريض انو صدره بكون مستقيم (barrel shape)

Airway resistance:

Major site for airway resistance ➡️ middle lobular and segemental bronchi
Sympathetic stimulation ➡️ bronchodilation ➡️ ⬇️ resistance
Parasympathetic stimulation ➡️ ⬆️ resistance by increase mucus secretion and bronchoconstruction

Surfactant & surface tension:

Surfactant is composed of : phospholipids + proteins + IgA , secreted by type 2 alveolar cells.
It decrease surface tension (⬇️ Transpulmonary pressure) لانو حسب قانون p=2*T/r تقليل tension
حيقلل ال pressure
so ⬆️ lung compliance

Clinical importance: premature babies will have immature lung (can't produce surfactant) so they are put on artificial ventilator with artificial surfactant until the lungs become mature.
➡️➡️ this condition is called respiratory distress syndrome.

Mechanism of surfactant:
Surfactant is a phospholipid mainly (non-polar) so it will occupy the surface of the fluid in the alveoli, so interaction forces between molecules will be decreased and surface tension will be decreased..🤍