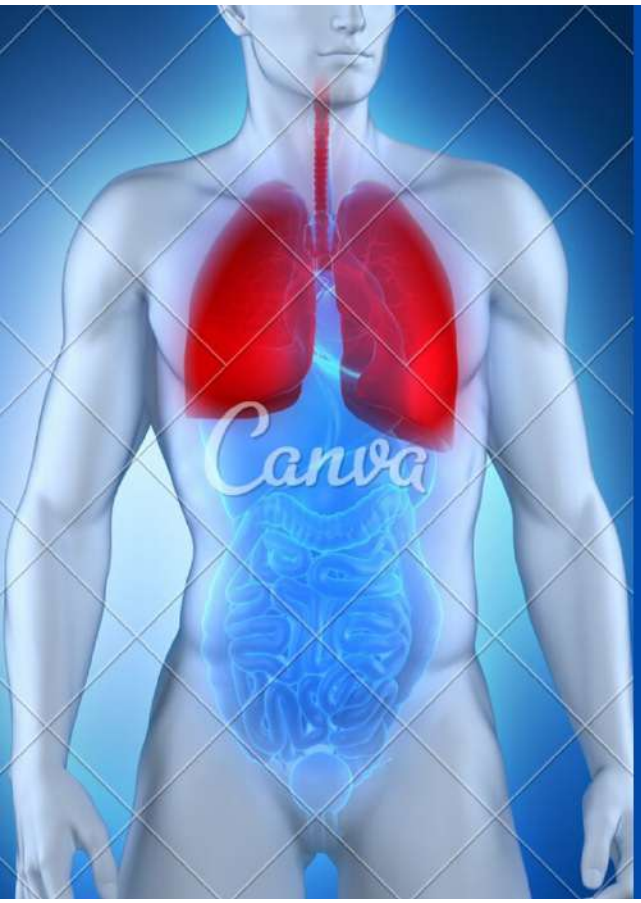


PASSION ACADEMIC TEAM

YU - MEDICINE

Sheet# 8 - PHYSIOLOGY

Lec. Date : 27 / 2 / 2020 CE .

Lec. Title : Regulations & Control Of Breathing

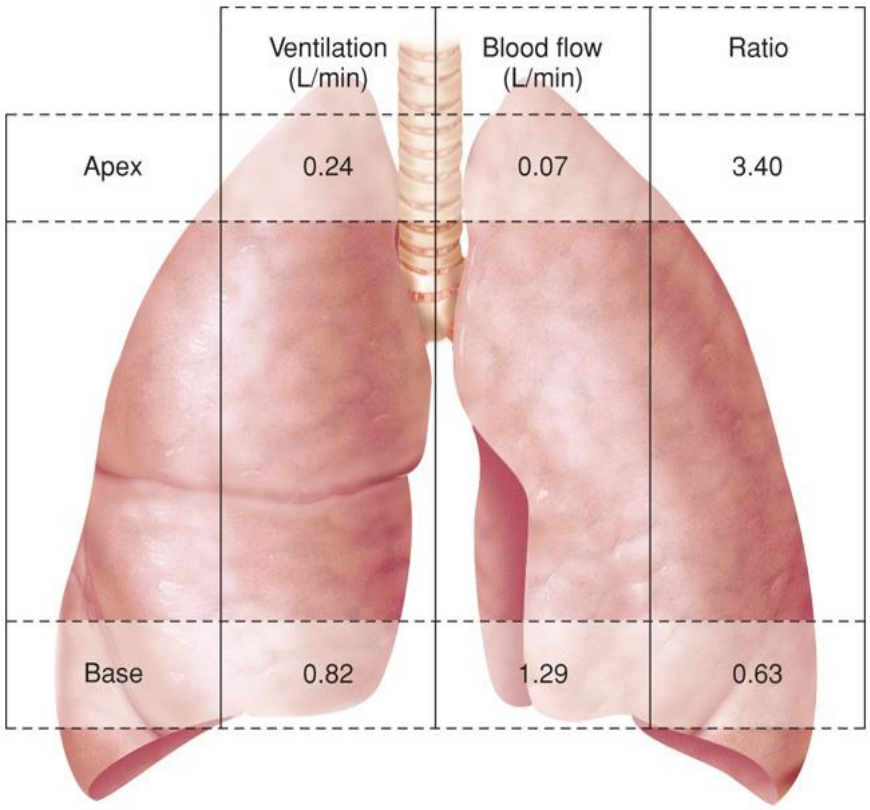
Written By : Wasan Ababneh

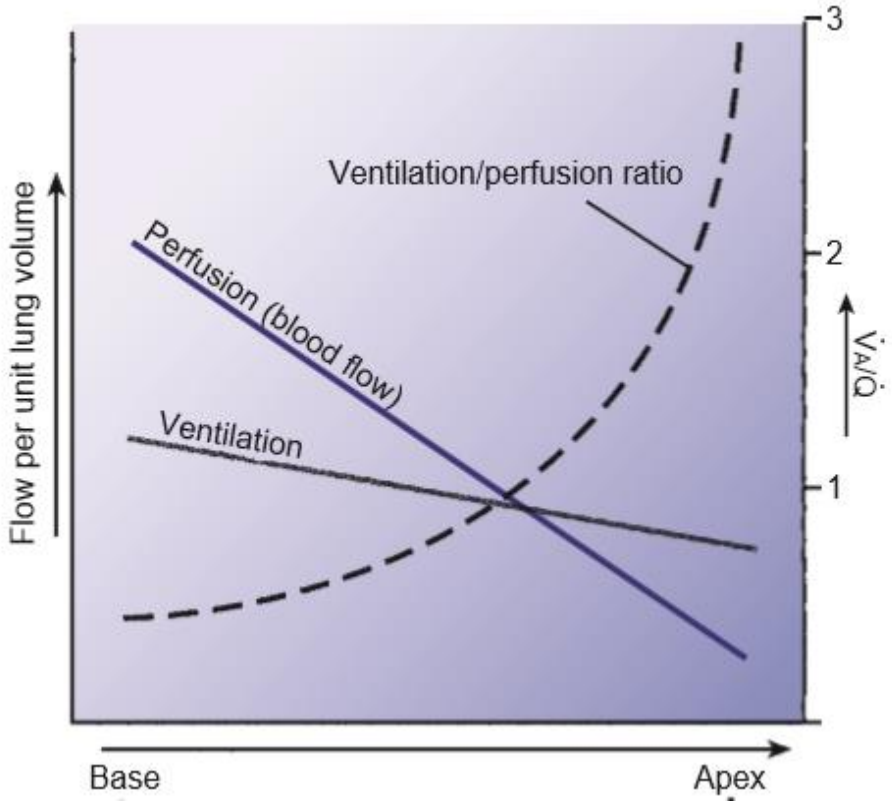
If you come by any mistake , please kindly report it to shaghafbatch@gmail.com

RESPIRATORY SYSTEM

ملاحظة : هذا التفريغ يحتاج إلى سماع ريكورد ولا يكفي التفريغ لوحده

Regional Differences in Ventilation/Perfusion Ratios





sheet#1

- perfusion increases from apex to base also ventilation increase from apex to base
- perfusion increase five(5) time more than in base than apex while ventilation increase two(2) time
- this mean that is more perfusion in base than ventilation because of this to the ratio ventilation/perfusion with be higher in apex than base
- perfusion/ventilation ratio increase from base to apex this mean that the ratio will be higher than one at apex alveoli and will be less than one at base because ventilation too high while perfusion low here,while in base perfusion is too hig compare ventilation this is mean that the alveoli in base highly ventilation.

sheet#2

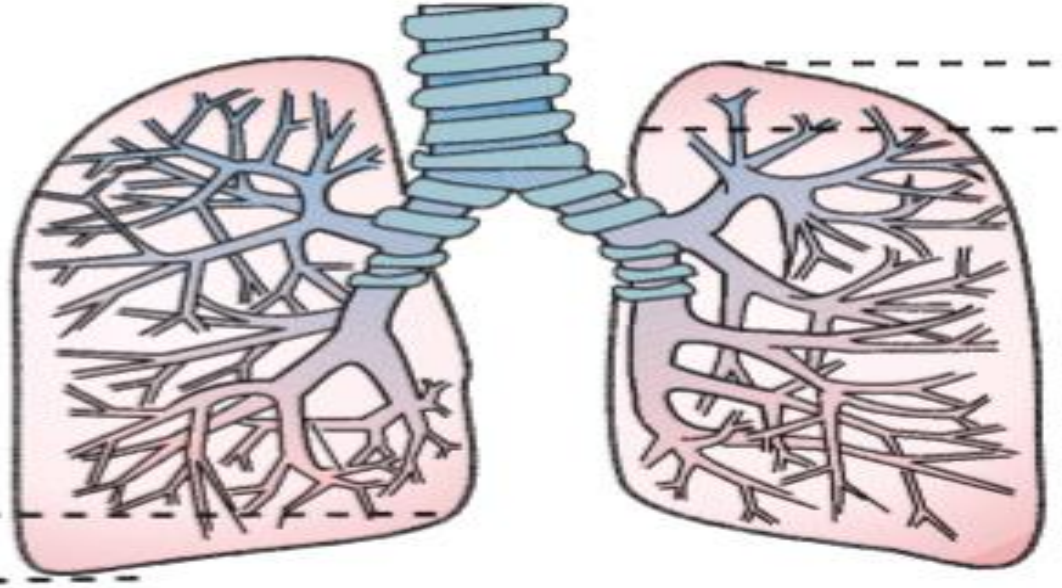
- كل هاي الاشياء سببها الجاذبية الارضية

- hydrostatic pressureبكون عناapex في مناطق

in pulmonary arteries or cappillary
this pressure(hydrostatic) is less than base pressure
*zone 1(apex) there is negativity affect the position(no perfusion)so the ratio very high
*Remember:
zone 1:apex
zone2:other portion (perfusion is intermediate)
zone3: base

Physiological Importance of VA/Q ratio

	$\dot{V}_A$ (L/min)	$\dot{Q}$ (L/min)	$\dot{V}_A / \dot{Q}$	Pao_2 (mm Hg)	$PaCO_2$ (mm Hg)	
	0.25	0.07	3.6	130	28	Apex
Base	0.8	1.3	0.6	88	42	



sheet#3

- In zone1(apex):P/V ratio more than one ,this mean more ventilation in apex and the arterial oxygen =130(partial pressure of O2 in arteries blood)so good oxygen supplement to blood, good Co2 removement (Co2=28)
- هو بالاصل كان 140 بس صارعندي تبادل

للغازات اكتر بهاي المنطقه لهيك قلت الى130

In zone3(base):P/V ratio less than one, this mean more perfusion in base and the partial pressure of O2 less than Co2.

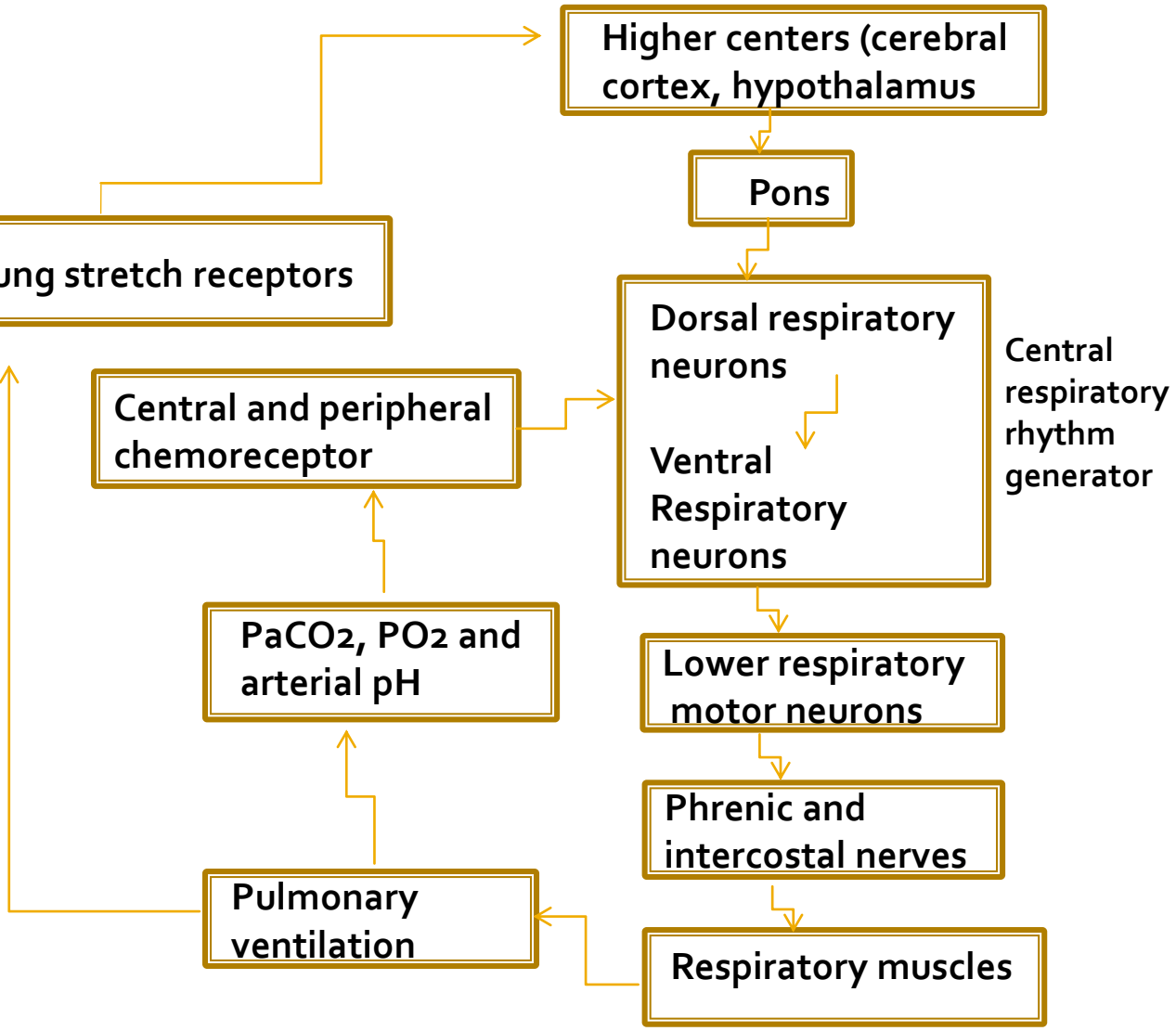
#overall P/V=0.8 (للرئه كامله)

REGULATION AND CONTROL OF BREATHING

REGULATION AND CONTROL OF BREATHING

Basic elements of the respiratory control system are:

- ✓ strategically placed sensors .
- ✓ central controller
- ✓ respiratory muscles.



sheet#4

- regulated and control of breathing are important to maintain partial pressure of O2 and Co2 within normal range and to regulate freqancy and depth of breathing.
- regulation of our breathing can whithin 2 part:
- 1-involuntary compensatory mechanism: you are controlling because artifactation it involuntary but your stretching it involuntary where is know everyone different in all circumstansis including siting when you are sitting this involuntary.

sheet#5

- 2-voluntary : when you are talking,singing swimming and holding of breath.
- we have free main element of component of control system that regulate our breating ,these 3 basic element are stratigitcaly place sensor to there sensor and these sensor could be chemeical and mechanical sensor.

sheet#6

- 1- chemical sensor can affect with any change in blood chemistry,eg:O2 and N concentration ,Po2 and Pco2. these sensor is located in stratigic places such as :camotid and oratic arteries.
- 2- mechanical sensor that can be taken of there is more extension of the lung or there is more inflation or more defltion .these sensor is central controler is located in central respiratory center to regulate respiration depth nd freqancy (increase or decrease)

sheet#7

- chemo receptor divide to 2 subtype:

1-central chemo receptor that are located in the oblingata in brain stem .

2-peripheral chem receptor that are located periphery in camotid and oratic arteries .

* machanical receptor (stretch receptor) have controlling center located either in high brain cortex ,in limbic system or hypothalamas and these center regulate voluntary baro respirtion

.

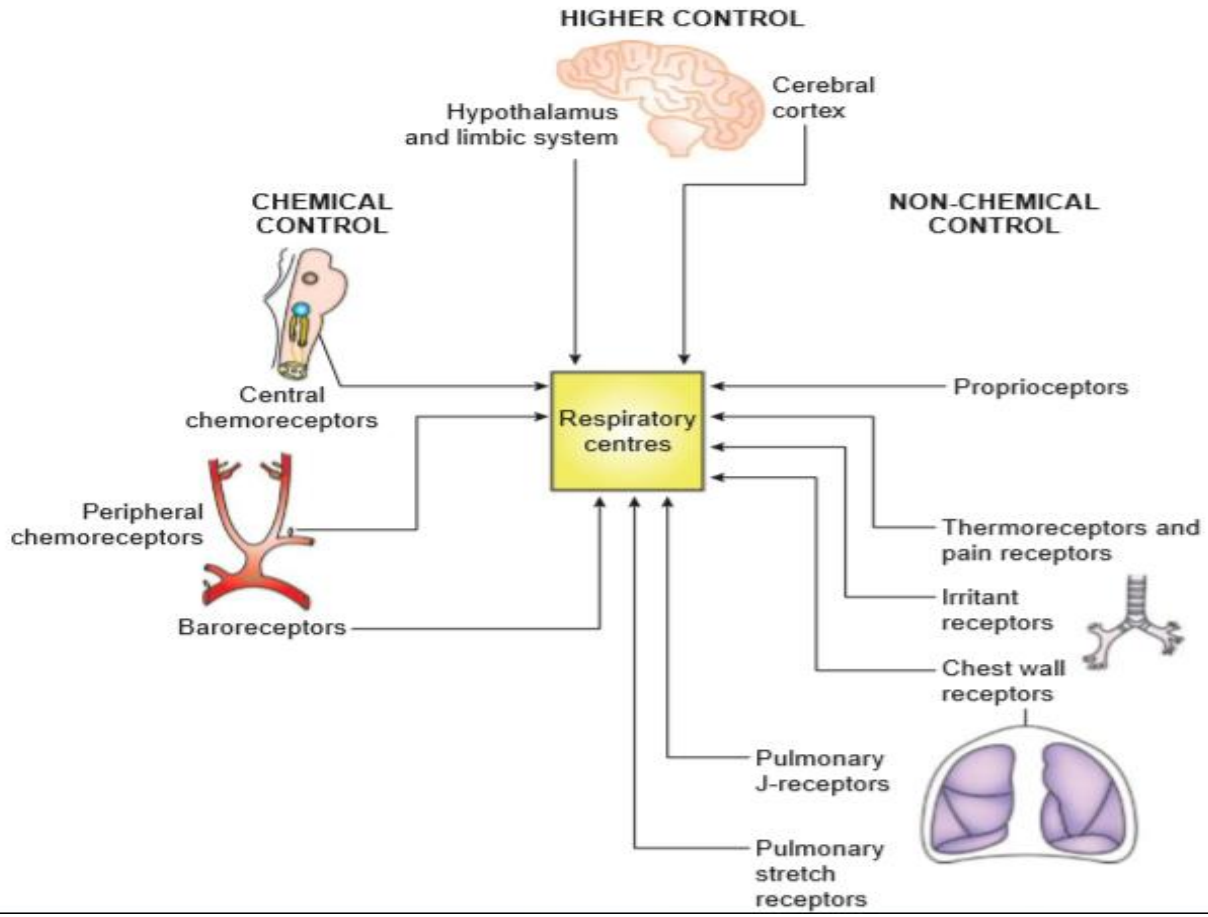
sheet#8

- we have center in brain stem and these centers regulate involuntary artification epthalamic ,one regulate cyclic ,one of these center located in brain stem in two areas in the bones and it also there is too center look about these to center and also we have to agingation of the neuron that regulate the involuntary respiration ,these respiratory neuron and peripherial respiratory neuron , so these are second major component

sheet#9

- wa have respiratory muscles , they found in costal ,scalenes, sternocleidomastoid and other of main and accessory muscle.
- نرجع للسلايد والرسمه بنلاحظ:
- efferent(motor neuron) which mean signal transmits from efferent to lower respiratory neuron in spinal cord .
- we have motor neuron in spinal cord from these motor neuron these nerves phrenic and intercostal are orginated then air expansion or disexpansion occur.
- لا ننسى المتغيرات الي ممكن تصير بالجسم وتاثر على التنفس سواء زياده بمعدل التنفس او نقصان متل
- Po2,PCo2,Ph andH +concentration.

AFFERENT IMPULSES TO RESPIRATORY CENTERS



sheet#10

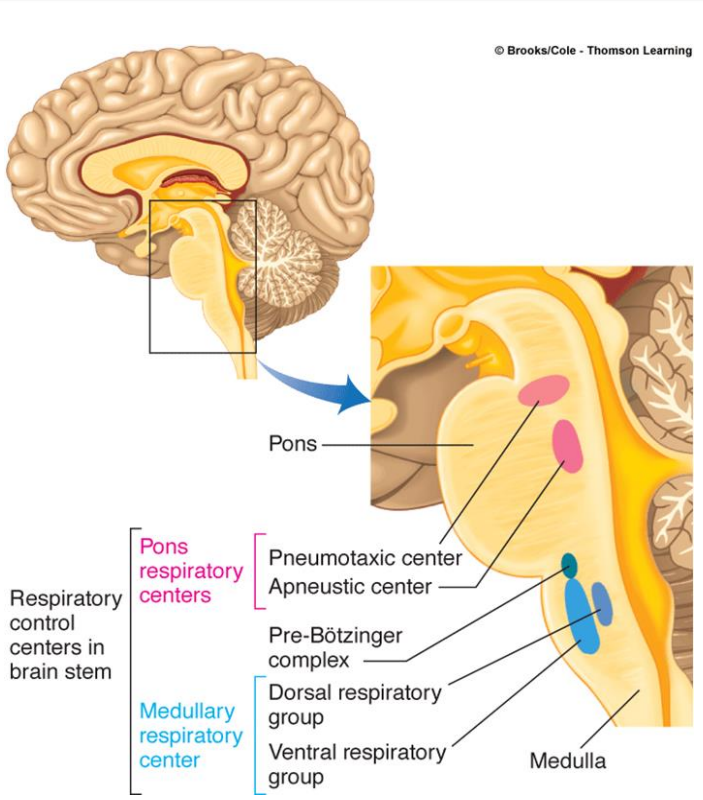
- receptor or afferent divides to 2 type:
- 1-chemical .
- 2-non-chemical.
- *baro receptor : mostly regulate blood pressure rather than respiration or some of them crosstoc whatever so changes in there receptor also changes respiration alittle bit.
- proreceptor :that stimulate by change in body movment ,these receptor mtly located in muscle and joint area.
- therma ,pain ,irritant and chest wall receptor: located mostly on conducting zone ,bronci and bronchioles
- pulmonary stretch receptor and central prephrial chemo receptor

CENTRAL CONTROLLER

Neural control mechanisms of breathing include:

- Involuntary control system of respiration in brain stem are:
  - Medullary respiratory centers
  - Pons respiratory centers
    - Respiratory motor neurons
      - Cervical Motor Neurons (C3-C5)
        - Phrenic nerves
          - Diaphragm
      - Thoracic Motor Neurons(T1-T11)
        - Intercostal nerves.
          - Intercostal muscles and the accessory muscles.
            - Reticular spinal tract

- Voluntary control system of respiration is located in the cerebral cortex
  - Respiratory motor neurons
    - Cervical Motor Neurons (C3-C5).
      - Corticospinal tract



sheet#11

- central control of respiration system is involuntary control located in brain stem ,while voluntary control located in cerebral cortex.
- involuntary :
- 1-medullary respiratory center :this is dorsal and ventral respiratory group ,responsable for otomatic ,rythmic respiration followed expiration but some type this process effect was taking alone ,the breath will be slow and irregular , so the intiation of rythmic breathing and cyclic is intiated in dorsal group via pre-botzinger complex this complex represences the place activity of respiration .

* silent بتكونquiet وفي حالةforced expiration في دورهاventral

sheet#12

- signal that intiation in medullary respiratory center is tnsmitted to spinal cord through reticular spinal tract *(tract=connection of nerve{axons}) particulary to neurons known as lower respiratory motor neurons.
- 2-pons respiratory center: wa have Apneustic and pneumotaxic center ,these center that regulate breath where action of these center they inhibit or stimulate there action.

sheet#13

- respiratopy motor neuron located in spinal cord in two region:
- 1-cervical region (C3-C5) :from these two nerves are orginated from motor neuron located in cervical area in C3-C5, while the intercostal neuron it is also orginated from respiratory motor neuron (بس بهاي الحاله respiratory motor neuron located in thoracic area consist of two motor neuron)
- these consist signals from medullary and cortex.

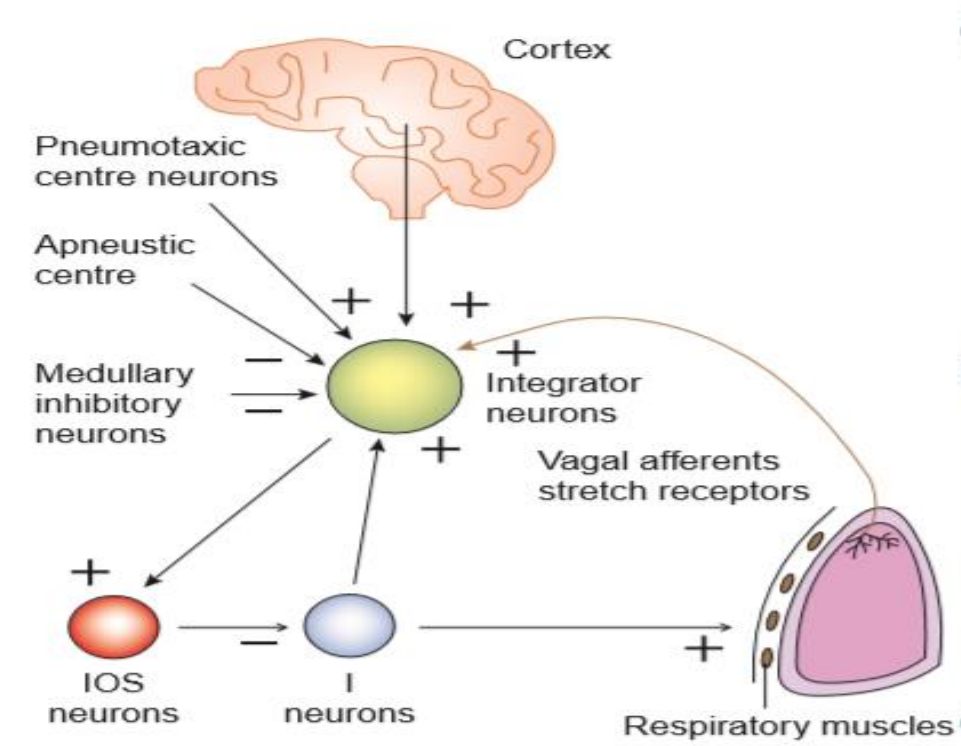
sheet#14

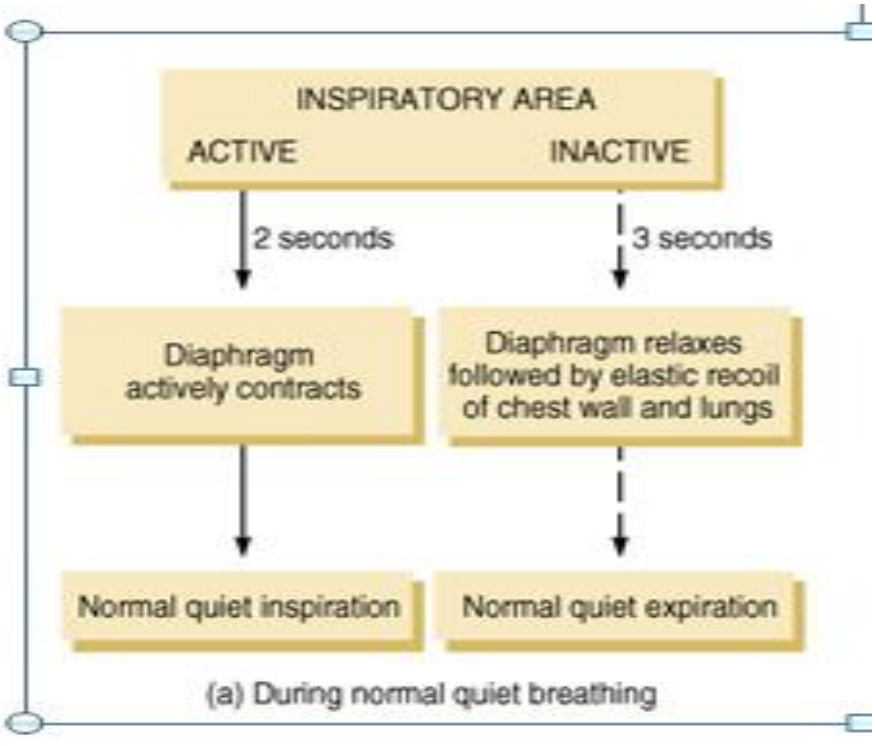
- in cotex no connection between higher control center with resp center in brain stem(the signals that are coming from the higher resp center bypass medullary resp center.
- وين بصير عندي؟synapsis
- synapsis with motor بصير عندي
- جايهsignal وفيهholding the breath لما نعمل from cerebral fromcortex high brain center
- signal from medullary وفيه
- synapsis with motor neuron located كلاهمابعملوا

in spinal cord also with crvical region or thoracic region
*which one over right to another?
when you are open your breath involuntary mechanism overright voluntary

*الشرح:
انت بتكتم نفسك لمدة دقيقه بعد ذلك بتتنفس اجباري لانه
صار زياده بCo2وهذه بتعمل للstimulation chemical receptor الي بدورها بتحفز
وبالتاليinvoluntary over right voluntary فبالتاليinvoluntary process انت بتتنفس اجباري
(involuntary)

Medullary respiratory center





- **The neurons of DRG are of three types:**
  - (i) **Inspiratory neurons (I)**
  - (ii) **Inspiratory off-switch (IOS) neurons**
  - (iii) **Integrator neurons.**

- **The DRG discharges rhythmically.**
- **The signals are not instantaneous. However, these signals are ramp signals.**

shee#15

- signals that are orginated from the higher brain center that are located in cortex
- why that these center and they do synapsis with respiratory motor neuron only located in cervical? because the diaphragm العضلة الرئيسيه(respiration) المسؤوله عن التنفس
- dorsal resp group has three type of cells:
- 1-(I) cells or neuron or inspiratory neuron ,so any stimulation of these cell cause inspiration .
- expiration تحدث بشكل تلقائي

sheet#16

- when stimulation to these cells ,signal transmitted to motor neuron located in spinal cord then phrenic transmitted to diaphragm cause expansion and change in pressure then inhalation occur.
- contamination توقفsignal هذه تنهيsudden inhalation

. بشكل تلقائي expiration وبالتالي بصير استرخاء للاعضاء يعني
* وبالتالي actine inspiration بكون عناforced expiration بحالة
. activation ventral group ثم

sheet#17

- 2-IOS neuron : which is inspiratory switcg off neuron ,so this switch inspiration there is off inspiration

- expiration يعني inspiratione لحد معين بعدين بصير
- IOS inhibit I neuron ,so they terminate inspiration .
- 3- integretor neuron .
- pons center regulate I neuron through pnemotaxic and apneustic centers.
- IOS neuron are regulated by signals coming from pons resp center (apneustic and pneumotaxic center) bot indirectly becaues these affect on integretor neuron which is doing synapsis with IOS

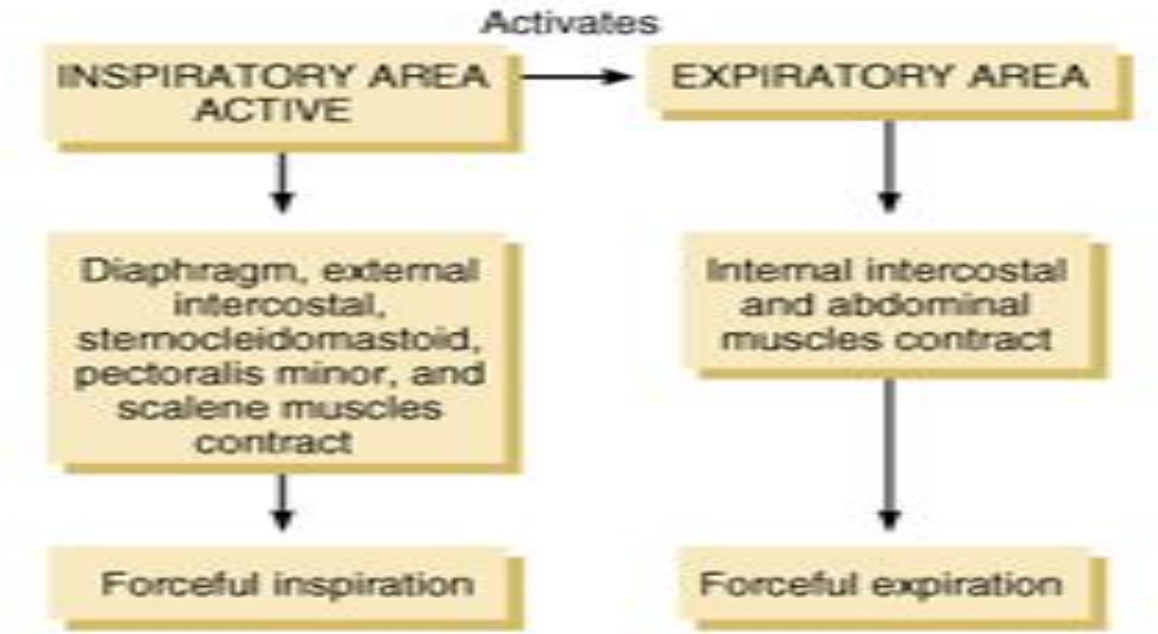
sheet#18

- integretor neuron stimulate IOS so I neuron is inhibited (inhibit inspirtion)
- integretor is stimulated by:
- 1-vagal afferent: expansionوstretching عندي بصير breathing يصير لما عندي stretch receptor at lung tissue لل تحفيز بصير وبالتالي معينه لدرجه
- and these receptor transmitted signals via vagal afferent to integretor neuron and stimulated these neuron.
- stimulate integretor……stimulate IOS……..inhibit I neuron (termination of inspiration)
- 2-pneumotaxic neuron : positively affect (result shallow and fast breathing)
- 3- I neuron : regulate itself (send positive signal to integretor)
- integretor is inhibited by apneustic center(no stimulation of IOS lead to apneusis (شهيق
- مستمر
- apneustic is inhibited by : pneumotaxic and vagal stimulation

sheet#19

- stimulation of I neuron leads to inspiration(dorsal resp group) and rythemic involuntary respiration , but this repiration or signals aren't instantaneous (isn't any media signals mean >these signals are ramp signals>
- weak signal increases for 2 second then they reach specific point at which there is ceastion of these signal and there is drop to zero again for 3 second= respiration(ramp signals).
- these process is regulated by pneumotaxic in normal breathing and sometime by vagal nerve

Ventral respiratory center



(b) During labored breathing

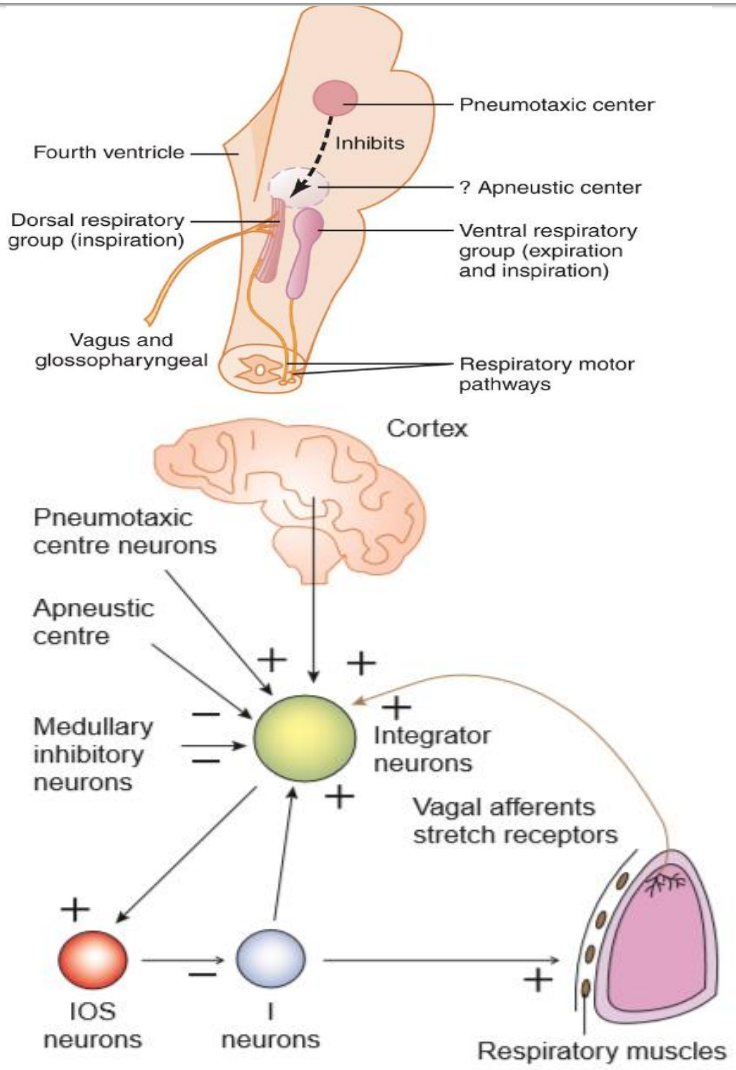
PONS RESPIRATORY CENTRES

Pneumotaxic center (upper pons)

- Sends continual inhibitory impulses to DRG of the medulla oblongata,
- As impulse frequency rises, breathe faster and shallower
- Strong pneumotaxic stimulation can increase the rate of breathing to 30-40 breaths/min and
- Weak pneuomotaxic stimulation can decrease the breathing rate to 3-5 breaths/min

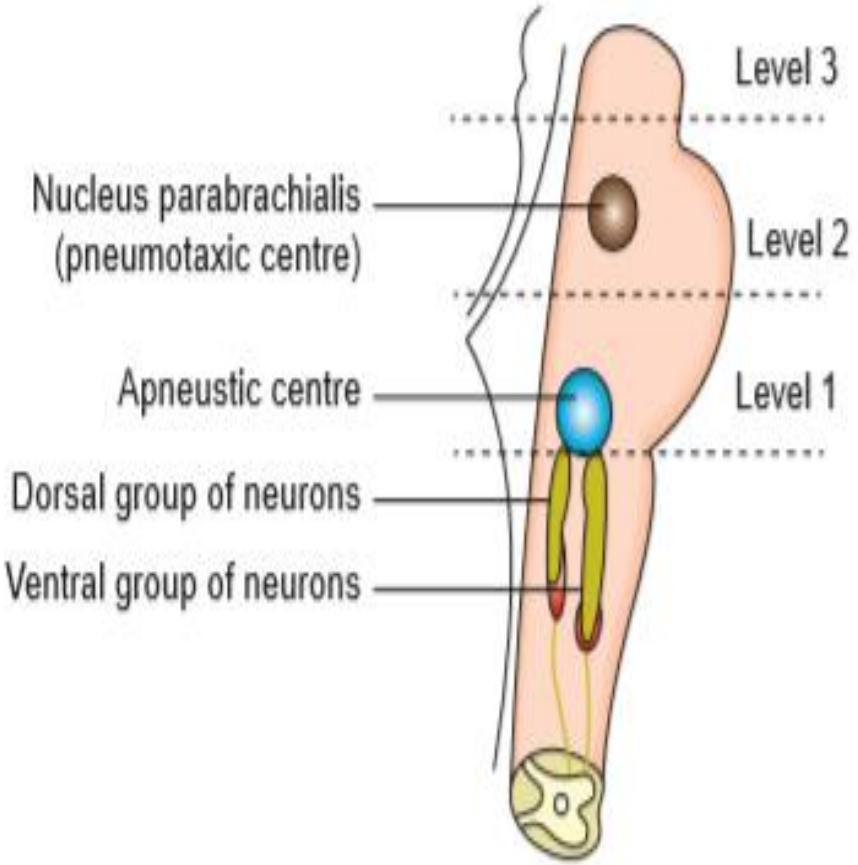
Apneustic center (lower pons)

- Stimulatory signals to DRG resulting in a deeper and more prolonged inspiratory effort termed as **apneusis.**



- pneumotaxic inhibits apneustic center (اذا لم يحدث تثبيط بصير عنا apneusis)
- وهذا بادي الى زيادة ثاني اكسيد الكربون بالجسم لانه الجسم ما بيقدر يعمل زفير (بيبقى في حالة شهيق مستمر) وقلة الاكسجين بالجسم وبالتالي بادي الى موت الخلايا
- pneumotaxic center sends inhibitory impulses so it is inhibit dorsal resp group.(shallow rapid breathing)

Experimental Observations



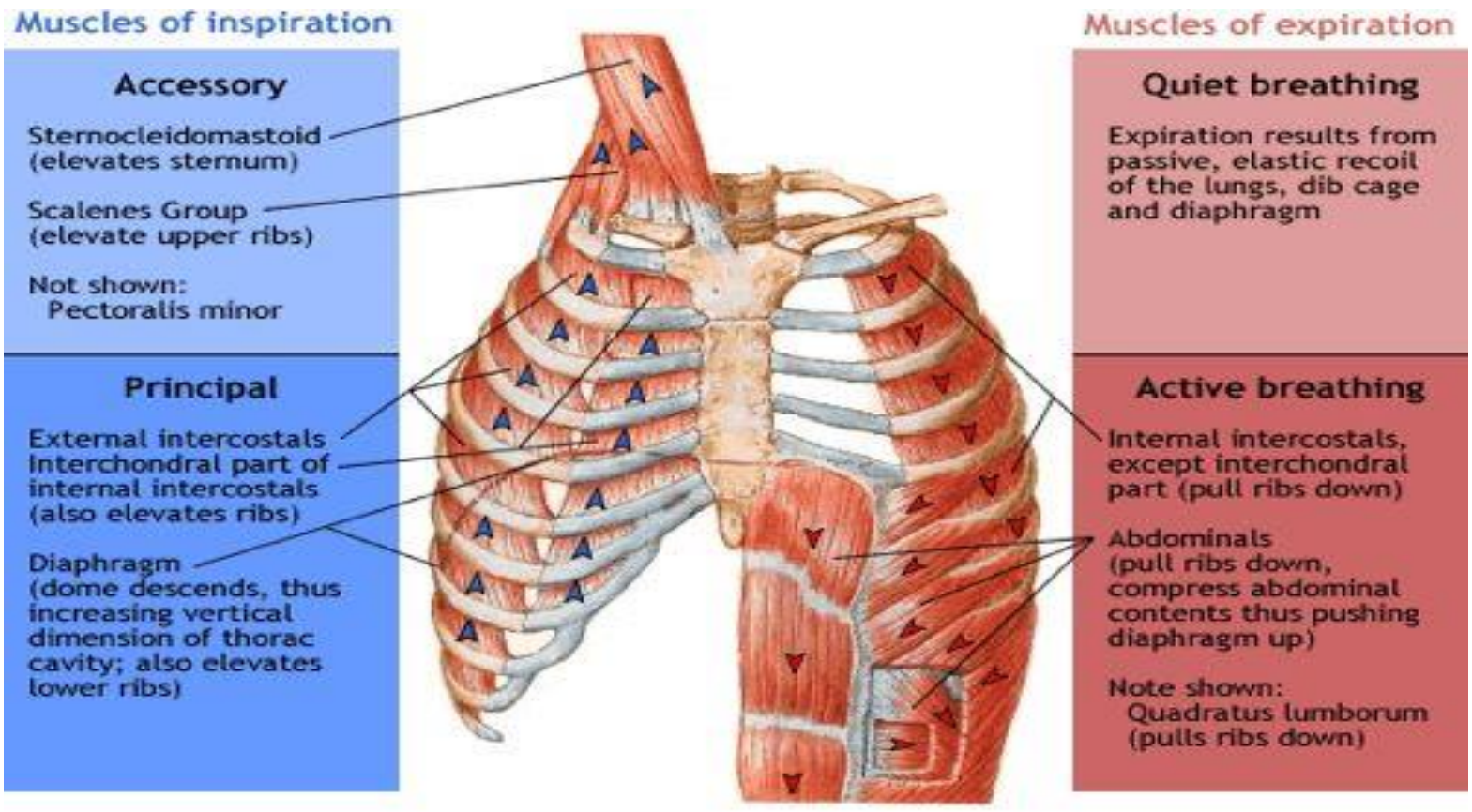
- ماذا يحدث لو صار1 damage in part؟

involuntary quiet breathing without pons center(slow breathing)

damage in part2?

*pneumotaaxic is not found but apneustic is found (apneusis)…. كمانvagus هون بحال افترضنا غياب

RESPIRATORY MUSCLES



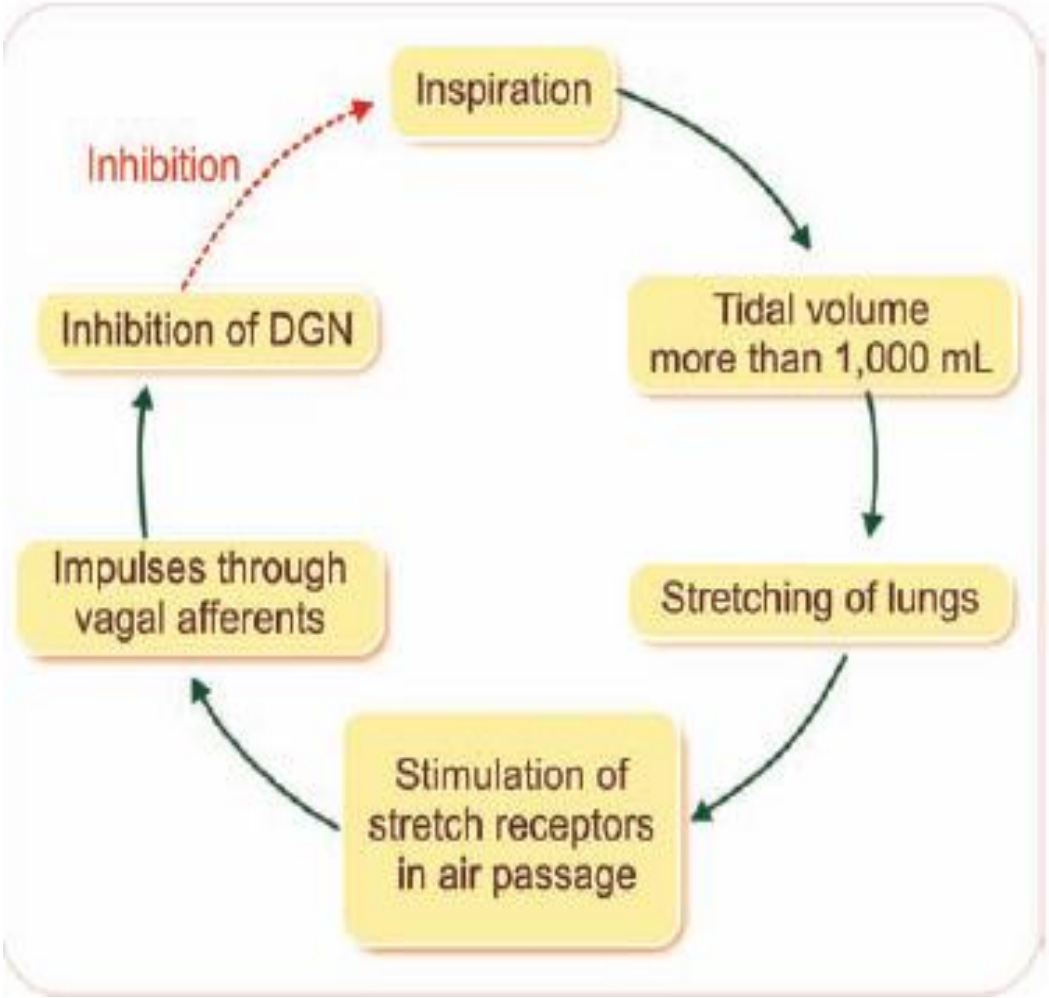
Sudden infant death syndrome

- resp muscle act at coordination way ,this cordination fasion is absent in newborn baby because they are not fully match so this lead to miss cordination between muscle so they cant act efficently (sudden infant death)

هدفك , اصرارك, صبرك ,قوة ايمانك بالله,ثقتك في قدراتك, كلها ادوات لتصبح ما تريد.....

SENSORS

1. **Lung stretch receptors.**
   - **Mechanoreceptors are present in the smooth muscle of the airways. When stimulated by distention of the lungs and airways, mechanoreceptors initiate a reflex decrease in breathing rate called the Hering-Breuer (inflation) reflex. The reflex decreases breathing rate by prolonging expiratory time.**



- hering breuer reflex:not very active in adult (expressed patyway in infant)
- لما يصير عنا شهيق هذا الشهيق بيعمل توسع

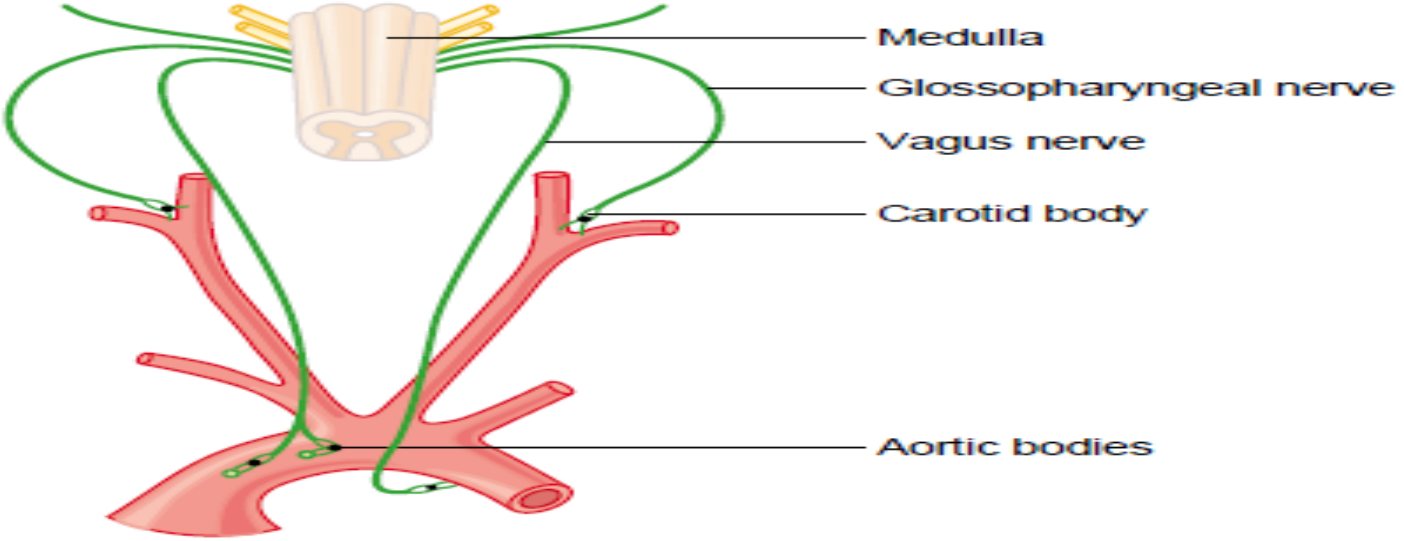
tidalvolume from500 to 1000 عالي جدا بالرئه بحيث بزيد and the stretch receptor that are located at lung tissu will be stimulated by this mechanical change and the signals will be transmited through vagal affwrwnt neuron to dorsal resp group =(inhibition of inspiration)

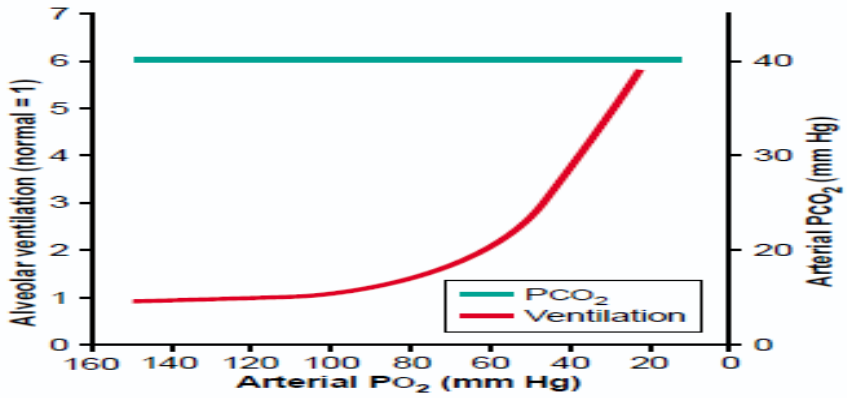
SENSORS

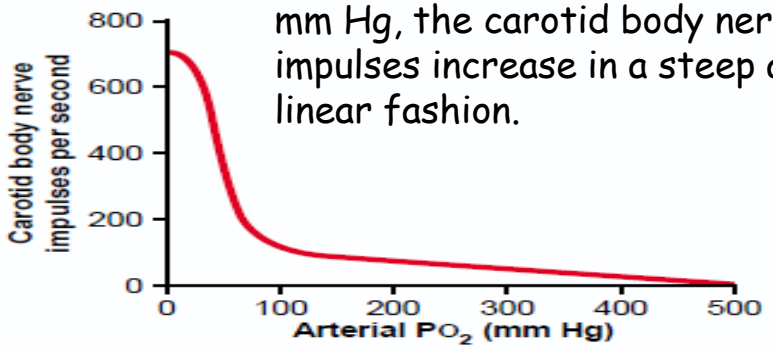
2.CHEMORECEPTORS:

- **are the sensory nerve endings, which are highly sensitive to changes in pCO_2, pO_2 and pH of blood. These are of two types:**
  - **Peripheral chemoreceptors**
  - **Central chemoreceptors**

Peripheral Chemoreceptors







if arterial PO2 is less than 60 mm Hg, the carotid body nerve impulses increase in a steep and linear fashion.

- شرح الرسمه: peripheral that are located in two ares at carotid arteries and tis location known as carotid bodies and also at aortic bodies also known as aortic bodies
- these 2 chemoreceptor highly sensitve for changes in arterial Po2 mostly when become less than 60,H+ that are indepedant on PCo2 which mean H+ that is indepedant on PCo2.

- يعني اذا صار زيادة فيPCo2 بصير فيه زيادة فيH+ وهاي بسموهاresp acidosis and the chempreceptor espically central they detect H+ that generated from metabolic acidosis

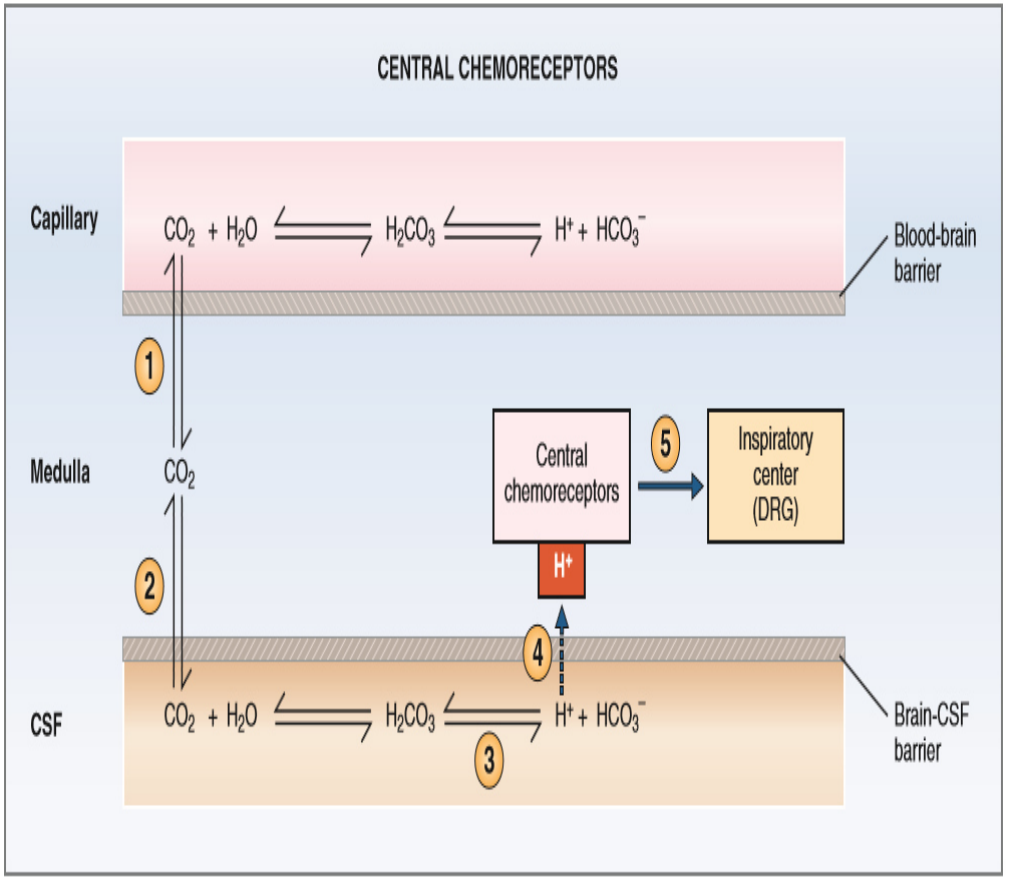
- in right picture:
- reduction in arterial Po2 to 60 and beyond there is linear and steep increase in inflation in arterial
- why at 60 specially?

buffering لانه بصير هناك
ولانه هاي النقطه تمثل نسبة الاكسجين الذائب في الدم بالتالي بصير لها تعويض

Central Chemoreceptors

The central chemoreceptors

- **located in the medulla, only a short distance from the DRG.**
- **highly sensitive to changes in blood PCO_2 or [H+] in CSF. However, not affected directly by $[CO_2]$.**
- **when $[CO_2]$ ↑ in blood → ↑ in CSF → $CO_2 + H_2O$ Carbonic acid bicarbonate + H+**



The buffering capacity of CSF is lower

- central chemoreceptor is directly and highly sensative for changes in H+ associated with more Co2 production and accumulation
- شرح الرسمه: عباره عن capillaries in CNS وهو عباره عن blood brain barrier(BBB) is impearable to H+ then this receptor doesnt respond to arterial H+ but respond to H+ which generated by Co2 in nervous system .

يعني لو عندك زياده H+الموجوده في الشرايين مش رح تروح ع medulla oplingata in brain على لانه ما بيستطيع اختراق BBB.

- penetration of Co2 رح يصير PCo2ولكن اذا صار زياده في from capillaries to interstatial fluid then cerebral spinal fluid so H+ producing from increasing Co2 can pass through brain cerebral spinal fluid barrier and activate central chemoreceptor

buffering capacity of cerebro spinal fluid is very very low compared with the buffering capacity of arterial blood .

تم بحمد الله.....

لا يضع الله حلما في عقلك الا وقد زودك بالقدرات التي تمكنك من تحقيقه, فلا تستسلم.....

Done By: Wasan Ababneh.