



Flow of air $= \frac{\Delta P}{R}$ $\rightarrow$ pressure gradient
 $\rightarrow R \rightarrow$ Resistance

* Flow of air $\propto \Delta P \rightarrow$ alveolar P - atmospheric P

* Flow of air $\propto \frac{1}{R}$

$\rightarrow$ Resistance is

$RT \rightarrow R_{\text{all}}$ $F = \frac{\Delta P}{R}$

* So, ΔP is the primary factor that affect

flow of air. R_{all}

$\frac{500 \text{ ml}}{F} = \frac{\Delta P}{R_{\text{all}}} \text{ 1 mmHg}$

$9 = \frac{5}{0.5} = \frac{5}{1} = 5$

Resistance

$$R = \frac{8 \eta l}{\pi r^4}$$

η → viscosity
 l → length
 r → radius

→ $R \propto \eta \cdot l$

→ η air & length constant

→ $R \rightarrow \frac{1}{r^4}$

→ $R \propto \frac{1}{r^4}$

$16 \uparrow$ → (2^4) → 4
 $\frac{1}{16}$ ← $(\frac{1}{2})$

normal → r (air) ↑↑↑↑

Distribution of airway resistance

↓ ↓ ↓ ↓ $R \rightarrow$ at very low resist

① - single

② medium size bronchi

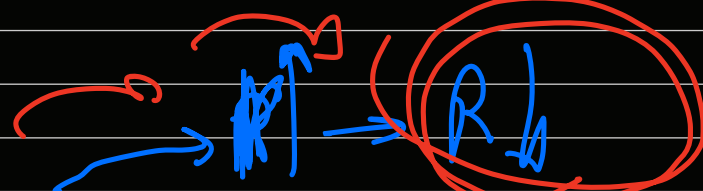
terminal Bronchiole

labor bronchus

$r \downarrow \rightarrow R \uparrow$

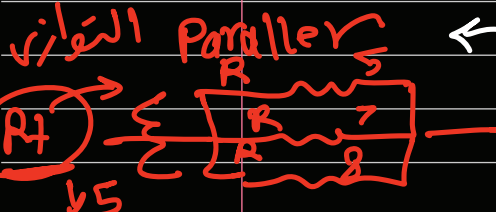
$r \uparrow \rightarrow R \downarrow$

Total $C \propto a$ → $R \uparrow$



③ small airways & bronchioles

respiratory terminal



Total cross sectional area $\uparrow\uparrow$



- ④ Pipe smoking $\xrightarrow{\uparrow\uparrow R} \downarrow R \downarrow \downarrow$
- ⑤ mouth breathing $\xrightarrow{\downarrow L} \uparrow R$
- ⑥ tracheostomy $\xrightarrow{\times URT} \downarrow L \rightarrow \downarrow R$

single Bronchus $\rightarrow r \downarrow \rightarrow R \uparrow$

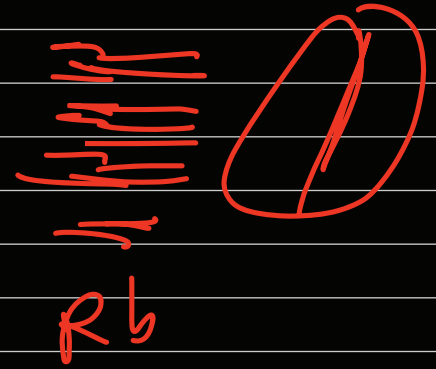
single Bronchus $\rightarrow r \uparrow \rightarrow R \downarrow$

bronchioles $\rightarrow$ TC SA $\uparrow\uparrow\uparrow$

$\leftarrow R \downarrow \downarrow$

medium

$\rightarrow$ TC SA $\rightarrow \downarrow \rightarrow R \uparrow$ ~~~~~



Factors affecting R

① Nervous Factor $\rightarrow$ tone $\rightarrow$ smooth muscle $\rightarrow$ bronchus

Para sympathetic $\rightarrow$

Autonomic

$\uparrow$ tone $\rightarrow$ smooth m $\rightarrow$ Broncho constriction $\rightarrow \downarrow r \rightarrow \uparrow R$

$\downarrow$ Flow $\rightarrow$ relaxation $\rightarrow \downarrow$ demand

$\downarrow$ tone $\rightarrow$ Bronchodilation $\rightarrow \uparrow r \rightarrow \downarrow R$

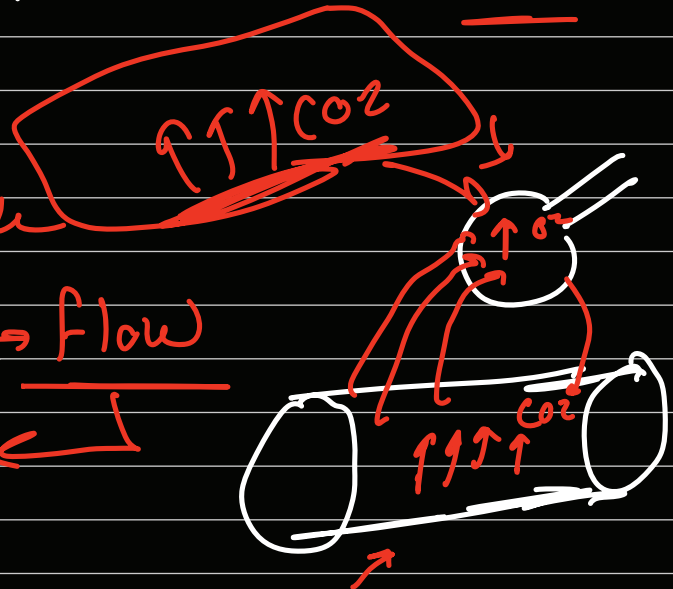
* clinical use $\Rightarrow$

bronchial asthma $\rightarrow$ $\uparrow R \rightarrow \downarrow R \rightarrow$ Air Flow

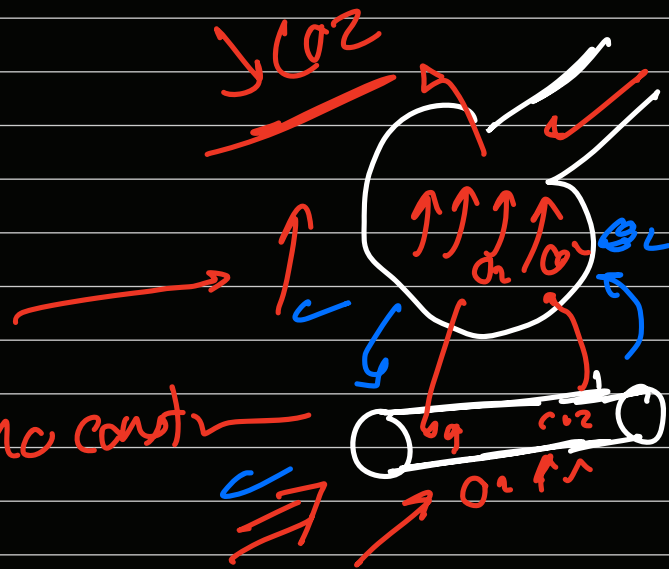
② Local control → [Airway smooth muscle is highly responsive to CO₂.

↑ Alveolar CO₂ ⇒
relaxation of smooth muscle
↳ Bronchodilation → ↓ R → flow

O₂

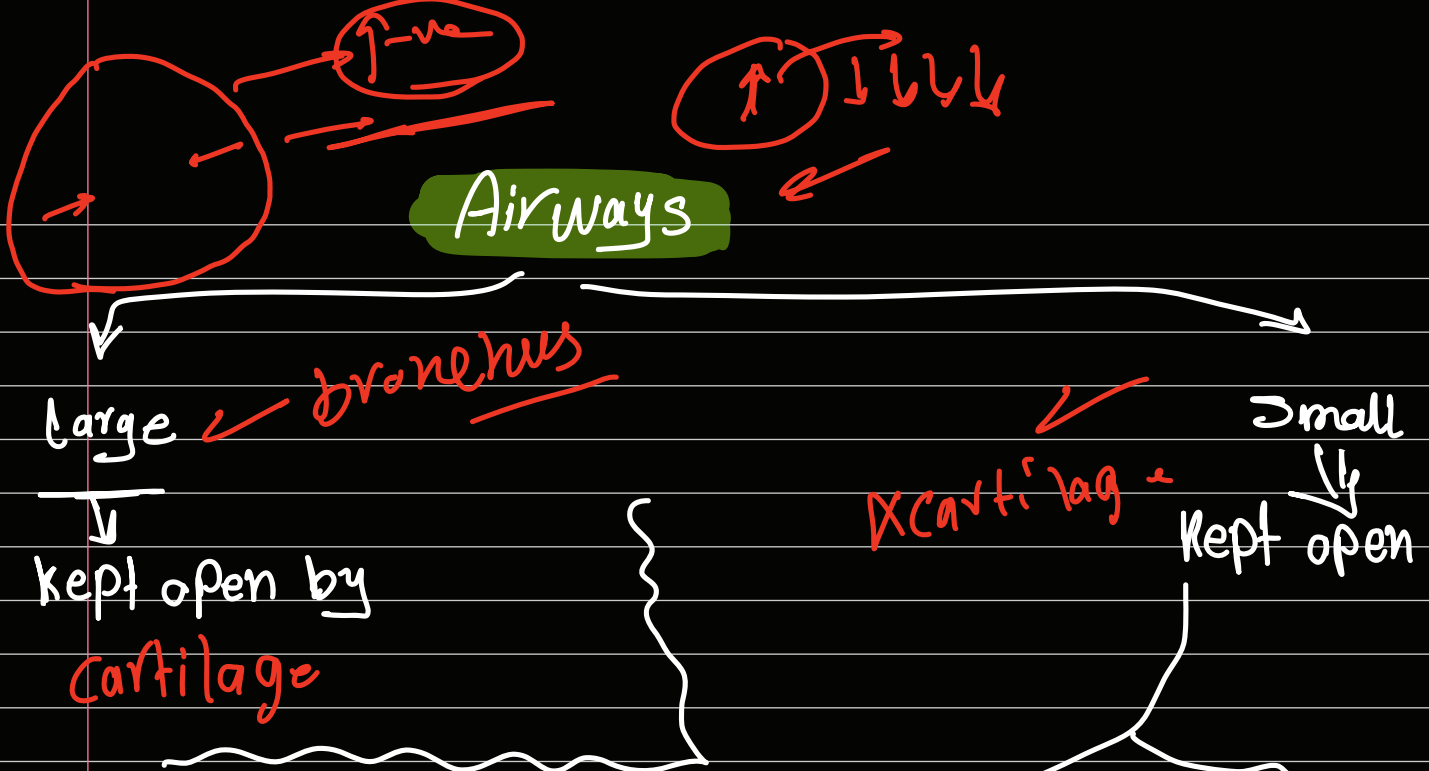


↓ Alveolar CO₂ ⇒
↑ tone smooth m → Broncho constriction
↑ R → Alveolar F

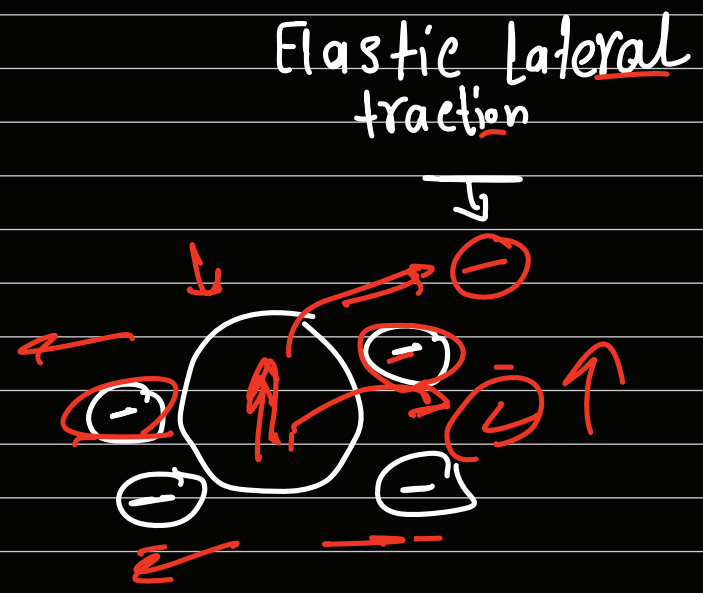
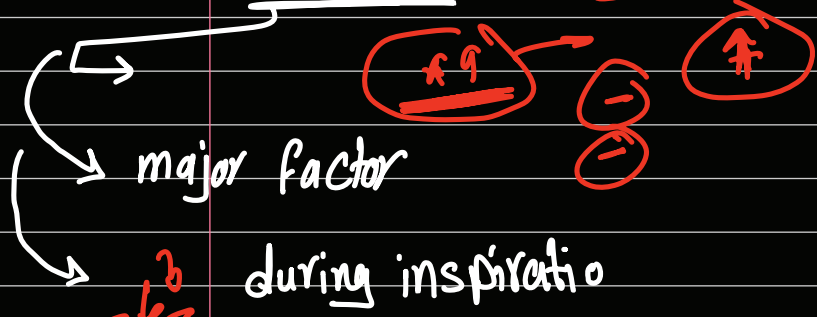


⇒ This mechanism → balance bet
Alveolar ventilation and capillary
perfusion





Transmural pressure gradient across air way



③ Pathological factors

→ $\uparrow R$ → Bronchial asthma
 → $\uparrow R$ → COPD → *Emphysema*, *chronic bronchitis*

need high pressure (work of muscles)

Smoking

Allergens

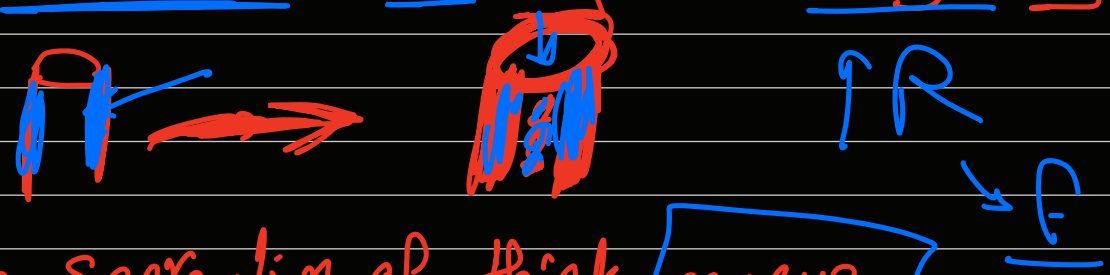
dust, pollen

$(F) \frac{DP}{R} \uparrow$
 $R \uparrow$

⇒ COPD → $\uparrow R$
 → difficult expiration

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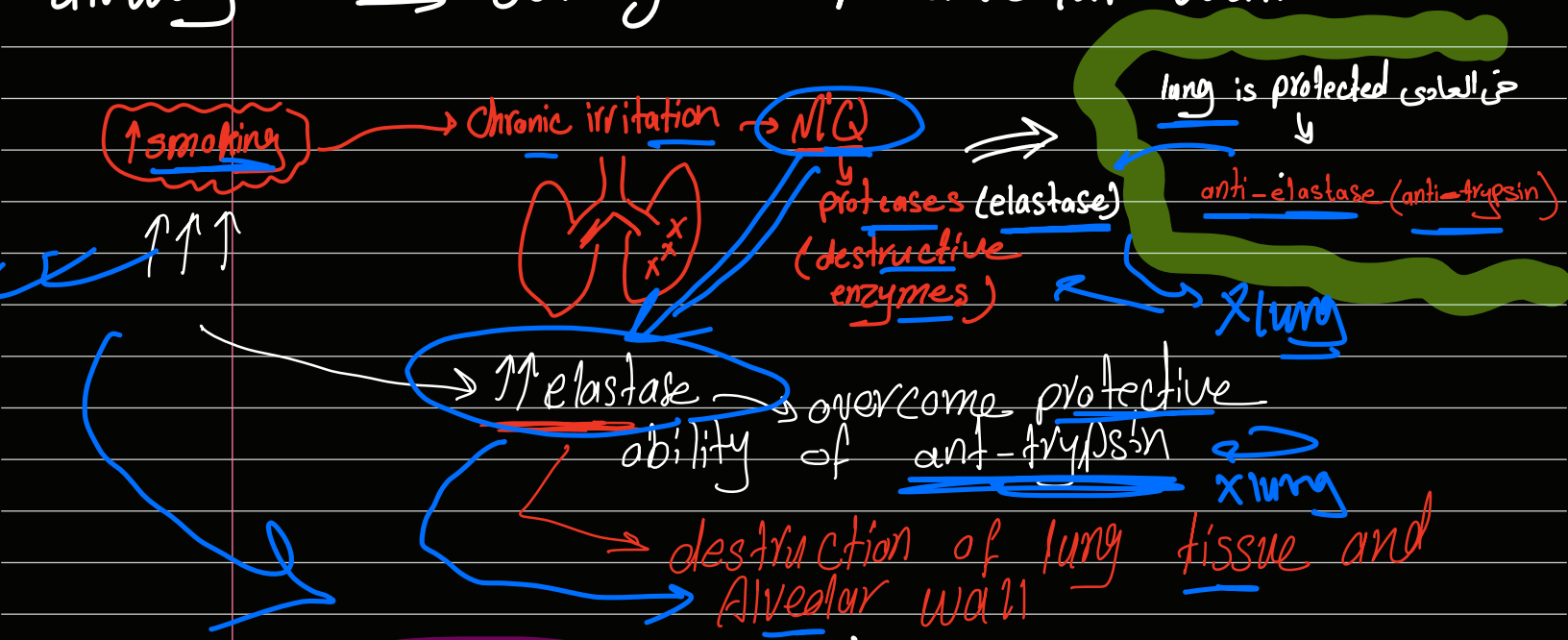
* Bronchial asthma → Attack of small airway
narrowing → airway hyperresponsiveness →
→ spasm of airway muscles and severe constriction.

Causes : → exposure to Allergen → release
of histamin
→ edematous thickening of airway lining

→ excess secretion of thick mucus.

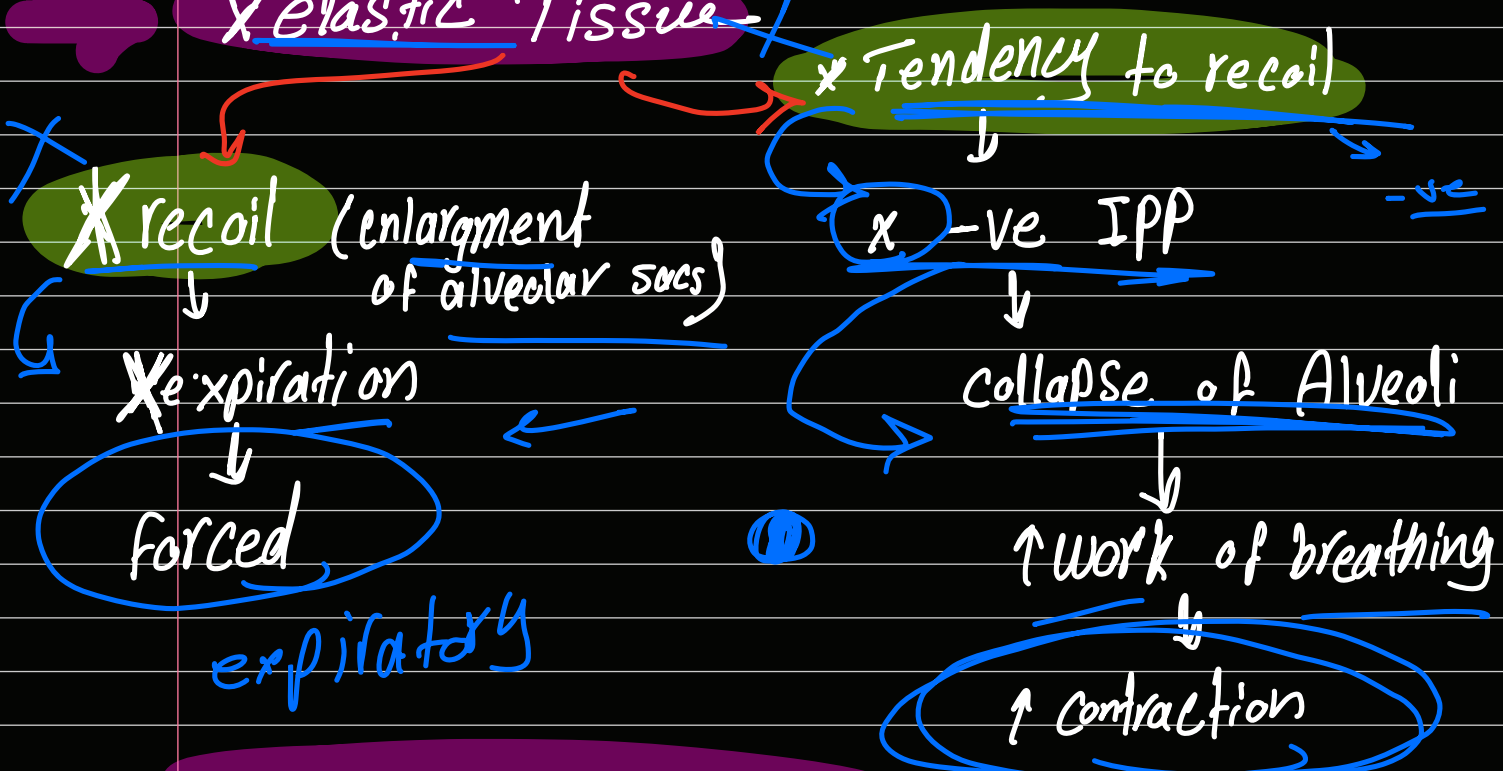
* chronic Bronchitis : → COPD
→ Long-term inflammatory condition of LRT
→ Histamin Release
→ edematous thickening of airway.
→ excess secretion of thick mucus.
⇒ Narrowing of airway

COPD

* Emphysema: irreversible collapse of small airway → damage of alveolar wall



* elastic Tissue



Damage pulmonary capillary

↓ surface area of alveolar-capillary membrane
→ XX Gas exchange.

smoking
lung

