INTRODUCTION OF  
RESPIRATORY SYSTEM

BY DR QAZI IMTIAZ RASOOL

Define respiration and identify different

levels of respiratory process and the contributing parts of the body.

2. Describe the physiological anatomy of the respiratory system (= List the parts of conductive zone and components of respiratory zone).

3. Discuss its functions of the conducting zone (= respiratory passages).

EXTERNAL AND INTERNAL RESPIRATION

**Physiologically, breathing is an activity of the respiratory system**

Stages of the Breath:

1. Inhaling Oxygen (Air) INTO the Body:

Inhalation (or inspiration) is active

breathing phase.

2. Gas Exchange in the Lungs:

3. Exhaling Carbon

**Pharynx**

**Larynx**

Lower Respiratory Tract  
(Tracheo-Bronchiolar tree)  
WEIBEL (1963)

1.Trachea

R+L main bronchi

2.lobar bronchi

3.segmental bronchi

4.bronchioles

5. TERMINAL BRONCHIOLES

1.RESPIRATORY BRONCHIOLEs

2.alveolar ducts

3.atria

4. alveolar sacs

conducting

zone

generations

1-16

respiratory

zone

primary lobule /

or acinus

generations

17-23

Generation Modifications

As the generation number ↑s :

1. Airways become **smaller, shorter and narrower**

2. The amount of **cartilage** in the wall ↓s

3. The no. of **submucosal glands** ↓s

4. The no. of **mucous-secreting cells** ↓s

5. The no. of **cilia** ↓s

6. The total **cross-sectional area** ↑s (2.5 cm2 in the trachea thru 180 cm2 in terminal bronchioles to 11,800 cm2 in the alveoli; about are in contact with capillaries7000cm2 )

Conducting Zone

**Some** amount of cartilage present up to **10th** generation(**prevent** collapse of airways ) and **absent** in **bronchioles**

**Bronchioles** Suspended by elastic tissue of lung parenchyma

First 16 airway generations lack alveoli and form the anatomical dead space.

Portion of the lung supplied by primary respiratory bronchiole is acinus

Functions of Conducting zone

**Support and patency** They distribute air evenly to deeper parts of lungs

* They serve as part of **Non-specific Defense System** of body by removing dust, bacteria and harmful gases from resp. tract

**Mucociliary escalator** Mucous lines the inner wall of airways like carpet & traps small foreign particles

**Provides a low-resistance pathway** for air flow; resistance is physiologically regulated by changes in contraction of

airway smooth muscle and by physical forces acting upon

the airways.

* **Warming, humidifying and filtering of air**.
* **Phonates (vocal cords).**
* **Cough reflex**

Respiratory Zone

**site of gas exchange**

Last **7** generations of airways

17-19 generation **respiratory bronchioles**

20-22 generation **alveolar ducts**

23 **alveolar sac**

This region is only approximately 5 mm long

Alveoli start budding off from 17 gen (~ **300** million)

All airways of a single terminal bronchiole (resp. bronchioles, alveolar ducts ‘n’ sacs) with associated blood and lymphatic vessels constitute a **primary lobule (terminal resp. unit)**

Resp zone supplied by **pulmonary circulation**

Extensive capillary network occupies **80%** of alveolar surface area

**Perialveolar capillaries** proximate blood to alveolar air—easy diffusion of gases

**Alveolus**

75-300 µm diameter

Total alveolar area in contact with capillaries in both lungs approx. 70m2

**Type I-flat cells**, primary lining cells of alveoli, covering 95% alveolar epithelial surface area

**Type II (granular pneumocytes)—**  → thicker, contain numerous lamellar inclusion bodies → secrete surfactant

→ imp. in alveolar repair

→ make up 5% surface area

→ represent 60% epithelial cells in alveoli

Other cells of alveolus

Pulmonary alveolar macrophages

Lymphocytes

Plasma cells

Mast cells containing

APUD cells

heparin, histamine, lipids &

proteases that participate in allergic

Respiratory membrane (air-blood barrier) or (Alveolar-capillary membrane) is composed of:  
**Primary function is gas exchange**

**Functions of   
respiratory bronchioles and alveoli**

**1.External respiration**

**2. Defence against microbes**

**1.**lymphocytes

2. plasma cells,

3. macrophages

**3. Warming and humidifying**

II. Non-respiratory functions

**a) Left ventricular reservoir=** 0.5 L of blood

b) **Filtering small emboli =** Clots, fat or air bubbles:

**c) Biochemical functions**= → **chemical substances** removed PGE2, PGF2a, leukotriens, serotonin and bradykinin; → 250 **volatile substances** removed i.e **methane**(from intestines), alcohol, acetone, etc.

**d) Olfactory function**

**e) Coughing and sneezing**

**f) Processing of inhaled air** –filtration of toxic substances & organisms

**g) Endocrine function**—converts ANG1 to ANG2

**h) Defense functions**=→ **alveolar & interstitial macrophages** remove particles < 2µm → **IgA**, **collectins** (including Surfactant A and D),

→ **defensins** and **proteases**, **reactive oxygen** PGE2

→ **chemokines and cytokines** secrete **(**immune cells)

**i) Metabolic functions—** synthesis of **surfactant** lyse clot (local fibrinolytic system)

synthesis of local hormones like histamine, kallikrein, PGs

j) **Temperature control=panting**

INTERESTING FACTS

Lungs are in a space with a volume of approximately 4 L, and surface area for gas exchange is the size of a tennis court (∼70-85 m2).

Adults, the lung weighs = 1 kg, with lung tissue accounting for 60%

Volume of the nose in an adult is 20 mL

Lymphatic channels are more abundant in the lungs than in any other organ

Circulation to the lung is unique in its dual circulation and ability to accommodate large volumes of blood at low pressure.