



# **MEDICAL UNIVERSITY - PLEVEN FACULTY OF MEDICINE**

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**Department of Pediatrics**

**Lecture № 10**

## **RESPIRATORY TRACT DISEASES. RESPIRATORY FAILURE**



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# THE ROLE OF THE RESPIRATORY SYSTEM

- To provide oxygen
- To eliminate carbon dioxide

A decorative graphic on the left side of the slide, consisting of a light green vertical bar and a dark blue horizontal bar with rounded ends.

# **DIFFERENCES INCREASING THE RISK OF RESPIRATORY FAILURE IN CHILDREN**

# AIRWAYS

- Smaller airway size
- The supporting cartilage is not developed
- The small airways muscle are incompletely developed
- Greater resistance in peripheral airways (an inverse proportion between airways resistance and airways radius)
- Young infant are less responsive to bronchodilator therapy

# ALVEOLI

- At birth only one-half of the adult number alveoli is present
- The number of alveoli increases most rapidly during the first year of life
- The parenchyma has reduced elastic content leads to poor alveolar support to airways
- Ventilation/perfusion ratio = 1:4

# CHEST WALL

- Chest wall is compliant (cartilaginous ribs)
- The infant ribs are in a more horizontal direction
- The infant chest has less displacement during inspiration and less reserve during respiratory distress
- The diaphragm inserts more horizontally on the inner surfaces of the ribs and lead to limited lung expansion

# RESPIRATORY MUSCLE

- In infant are not fully developed
- Lack of power
- Lack of tone
- The weakness reduces respiratory efficacy
- In infant diaphragm plays a major role to generate tidal volume
- Infants under 4 months old are obligate nose-breather

# LUNG VOLUMES

- Total lung capacity:

1. Vital capacity:

- Inspiratory reserve volume

- Tidal volume** (resting expiratory level)

- Expiratory reserve volume

2. Residual volume



# PULMONARY DISEASES

## **Restrictive group:**

- Diseases of the lung parenchyma
- Impaired ability of the lung to expand

## **Obstructive group:**

- Narrow airways
- Reduced vital capacity

## **Duration:**

- Acute – less than 3 weeks
- Subacute – between 3 weeks and 3 months
- Chronic – longer than 3 months
- Recurrent – illness is discontinuous with intervals of well-being

# CRITERIA FOR RESPIRATORY FAILURE

- Tachypnea
- Dyspnea
  - Severe retraction of the chest wall
  - Use of accessory muscles ( increased respiratory effort)
  - Use of alae nasi (nasal flaring)
  - Visible contraction of the sternocleidomastoid muscles (lead to head bobbing in young infants)
  - Expiratory grunting
  - Stridor
  - Noisy breathing
- Cyanosis
- Tachycardia
- Decreased or absent breath sounds
- Depressed level of consciousness

# PHYSIOLOGIC PARAMETERS

- $\text{PaO}_2 < 60 \text{ mm Hg}$ 
  - 1-st degree
- $\text{PaO}_2 < 60 + \text{PaCO}_2 > 60 \text{ mm Hg}$ 
  - 2-nd degree
- $\text{PaO}_2 < 60 + \text{PaCO}_2 > 60 \text{ mm Hg} + \text{Ph} < 7,35$ 
  - 3-rd degree

# CAUSES OF RESPIRATORY FAILURE

## INFANTS

- Pneumonia
- Bronchiolitis
- Upper airway obstruction
- Congenital heart disease
- Cystic fibrosis

# CAUSES OF RESPIRATORY FAILURE

## OLDER CHILDREN

- Pneumonia
- Asthma
- Croup
- Peritonsillar abscess
- Foreign body aspiration
- CNS infection
- Neuromuscular disease (Guillain-Barre-syndrome, Spinal cord injury)
- Metabolic acidosis (Diabetes mellitus, Salicylism)
- Anemia

# PATHOPHYSIOLOGY

- **VENTILATION**

- Control by respiratory **center** in the pons and medulla
- Gas transport through the large and small **airways**
- Gas exchange in the **alveoli**

- **DIFUSION OF THE OXYGEN THROUGH THE CAPILLARY /ALVEOLAR WALL**

- **PERFUSION OF THE PULMONARY CAPILLARIES**

# LABORATORY

- Arterial blood gas analysis – arterialized capillary blood or arterial oxygen saturation (oxymetry)
- Chest X-ray
- Electrolytes
- Complete blood count
- ECG
- Toxicology screen
- Lumbar puncture
- Computed tomography scan of the head
- Laryngoscopy
- Bronchoscopy
- Measurement of the lung volumes

# THERAPY

**Admission to hospital** ( observation in Intensive care department)

**Oxygen** – equipment and oxygen delivery system:

- Nasal canula (prones)
- Face mask
- Oxygen hood
- Oxygen tent
- Incubator for preterm newborns
- Oxygen catheter
- Endotracheal intubation
- Mechanical ventilation



# THERAPY

## Intravenous fluid therapy

Correction of the metabolic acidosis – Astrup's formula:

- $8,4\% \text{ NaHCO}_3 \text{ (ml)} = \text{BW kg} \times 0,3 \times (-\text{BE})$

## Digitalization

- Diuretics

## Bronchodilators:

- Adrenergic agonists (Ventolin, Salbutamol)
- Methylxantins (Theophyllin)
  - 10-20 mg/kg, oral
  - 5mg/kg/6 h i.v 20-30 minutes
  - 0,5-1 mg/kg/h continuous intravenous infusion
- Cholinergic antagonists (Atropin, Ipratropium inhal)

# THERAPY

**Corticosteroids (Urbason 1-2 mg/kg i.v)**

**Antibiotics**

**Mucolytics**

**Aspiration of fluid from the plural space**

**Aspiration of the upper respiratory tract**