Nursing 101-Unit V Respiratory -ABG Lecture-Exam 1

- **Introduction-Objectives**
  - Focus on respiratory acidosis and alkalosis
  - Identify clinical signs and symptoms of ↓$PaCO_2$ and ↑$PaCO_2$ & common causes
  - Describe inadequate oxygenation, clinical signs, & symptoms
  - Discuss other lab results to consider
- **Definition**-blood test taken from an artery that measures oxygen and CO2 found in blood
- **Exchanging Gases**
  - Gas Exchange-occurs rapidly via millions tiny thin membrane alveoli
  - **Inside air sacs**-Inhaled O2 diffuses into blood while CO2 diffuses from blood & is exhaled
  - **Blood**-circulates delivering O2 & picking up CO2, returns to lungs for oxygen
  - **Acid**-can donate a hydrogen ion
  - **Base**-can accept a hydrogen ion
  - **pH-**represents concentration of hydrogen ions
  - **Anion Gap**-helps determine if metabolic acidosis or acidosis
- **Regulation**
  - **Chemical buffers**-Bicarbonate, Organic Phosphates, Proteins
  - **Respiratory regulation**-CO2 thru rate & depth of respirations, 50-75% effective, occurs in 1-3 minutes
  - **Renal Regulation**-Bicarbonate level, retention, secretion

- **ABG Normal Ranges**
  - pH 7.35 – 7.45
  - $PaCO_2$ 35 – 45 mmHg
  - HCO_3 22 – 26 mEq/L
  - PaO_2 80 – 100 mmHg
  - SaO_2 96 – 100%

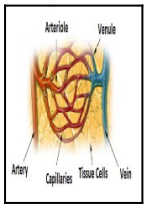
- **Why do we need ABGs-Assess the following**
  - Acid base balance
    - respiratory
    - metabolic
    - combined
  - Ventilation status
  - Oxygen therapy
  - Change ventilator or BiPAP settings

- **Prior to ABG Draw**
  - Arterial puncture-blood draw to evaluate oxygenation, usually radial artery
    - Allen's test: Confirms ulnar circulation is adequate
    - Results can be indication for intubation
      - https://www.youtube.com/watch?v=gdgomN6TsuE
- **Physiology**
  - PaO_2/ $PaCO_2$ exchange by: diffusion-_____
    - Alveolar O_2 = 100mmHg
    - Alveolar CO_2 = 40mmHg

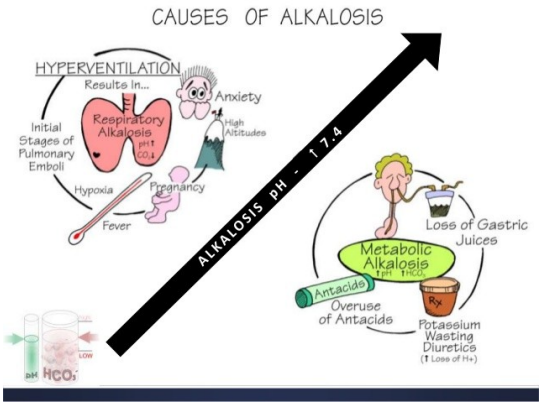
  - Desaturated blood → Saturated Blood
    - **PvO_2 = 40mm Hg → PaO_2 = 97mm HG**

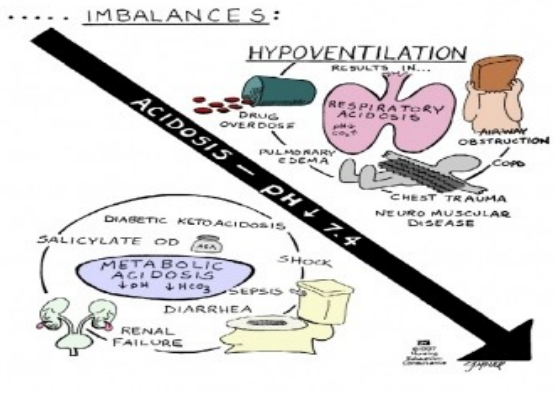
- $PvCO_2$ = 46mm Hg → $PaCO_2$ = 40mm Hg
  (Venous) (Arterial)

- **Physiology Respiratory**
  - Medulla (respiratory center) controls depth of breathing & rate of CO2 secretion
  - Increased PaCO2 stimulated medulla to increase rate & depth of breathing to blow off CO2
  - Decreased PaCO2-inhibits rate & depth of breathing to retain CO2
- **What is the stimulus to breathe?**
  - CO_2 Narcosis
  - Respiratory center loses sensitivity to elevated levels of **CO_2**
    - Theoretically O_2 drive to breathe is hypoxemia
  - Not providing adequate oxygenation is more detrimental than concern for increased Pa**CO_2** levels
- **Physiology Renal**
  - Acute respiratory acidosis takes hours for HCO_3 to elevate for compensation
  - Chronic respiratory acidosis
    - Kidneys have been compensating all along since $PaCO_2$ is chronically high
    - So HCO_3 (Bicarb) is elevated on admission ABGs for these COPD patients



- **Physiology Pulmonary Airways**
  - **Constricted** by Histamine, Decreased PaCO2, PNS (peripheral nervous system)
  - **Dilated** by Epinephrine, Increased PaCO2, SNS (sympathetic nervous system)
- **Pulmonary Arterioles**
  - Effects opposite on systemic arterioles
    - Constricted by decreased PaO2, increased PaCO2, decreased HCO3 (acidosis)
    - Dilated by increased PaO2,decreased PaCO2,Increased HCO3 (alkalosis)
- **"Causes of Alkalosis" & Imbalances "Acidosis"**





- **ABG Interpretation**

- Determine pH (**acidosis or alkalosis**)
- Analyze $PaCO_2$ (lungs)
- Analyze HCO_3 (kidneys)
- Are all WNL? If so, ABG is normal.
- If abnormal, determine if Pa CO_2 or HCO_3 matches the pH (cause- **acidosis or alkalosis**)
- After determining the cause, look at the *OTHER* factor. Is there compensation?

– **Review Examples**

– **<u>Compensation</u>**

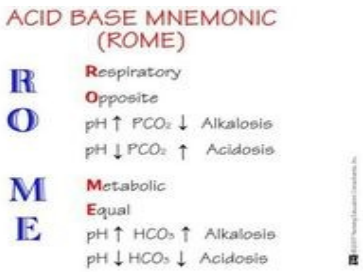
- **First Name**
  – Completely Compensated (pH 7.35 - 7.45 with the "*OTHER" factor being abnormal)*
  – Partially Compensated (pH < 7.35 or > 7.45 with the "*OTHER" factor being abnormal)*
  – Uncompensated (pH < 7.35 or > 7.45 the "*Other" factor is normal*)

- **Middle Name (whoever matches the pH)**
  – Respiratory (CO_2)
  – Metabolic (HCO_3)
- **Last Name (based on the pH)**
  – Acidosis (CO_2 > 45 &/or HCO_3 < 22)
  – Alkalosis (CO_2 < 35 &/or HCO_3 > 26)

*Adapted from Advance for Nurses (1/10) p. 2

- http://www.youtube.com/watch?v=zb51W7C93HM
  – Laura Gasparis video on ABGs

– See ROME Mnemonic



– ABG Analysis			
– pH=	7.28	7.41	7.34
– $PaCO_2$=	70	25	60
– HCO_3=	22	15	34
– pH=	7.35	7.48	7.54
– $PaCO_2$=	58	22	26
– HCO_3=	27	17	22

– **<u>Oxygenation</u>**

– Goals of O_2 therapy
  – Provide adequate oxygenation to all tissues
  – ↓ work of breathing

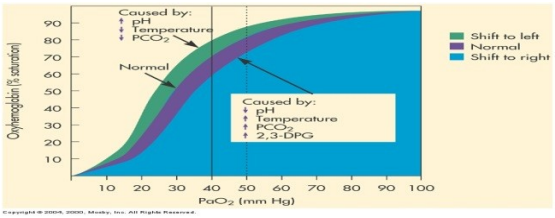
- No use of accessory muscles-scalenus, supraclavicular, intercostal retractions

- **Terms**
  - **Hypoxemia**: decrease in arterial blood O_2 tension; generally defined as: PaO_2 <55 or SaO_2 <88% on room air at sea level
  - **Hypoxia**: decrease in oxygen at the tissue level
- **Normal arterial values**
  - **PaO_2** = 80 -100 mmHg
  - **SaO_2** = ≥ 96% (or > 95%)
  - **A normal PaO_2 guarantees adequate tissue oxygenation**
- **Oxygen is carried in the blood in two forms**
  - Partial pressure of oxygen dissolved in blood: **2-3% of oxygen is dissolved (PaO_2)**
  - Percentage of Hemoglobin carrying oxygen compared to the total amount of Hgb.: **97 - 98% of oxygen is on Hgb. (SaO_2)**

- **Oxygenation Critical Thinking**
  - What does the SpO_2 (pulse ox) reading reflect?
  - What is a normal pulse ox reading?
  - What is considered an **adequate** pulse ox reading in **most** patients and what does it reflect?
  - How is the physicians' order frequently written in regards to pulse ox assessments?
  - The SpO_2 = 95% and the Hgb. = 7.0: Is oxygenation adequate and why?

- **Oxygenation-Oxy-hemoglobin Disassociation Curve**

  Demonstrates relationship between PaO_2 (dissolved) & SaO_2 (hgb.)



  - 30-60-90 rule: describes relationship between PaO_2 & SaO_2
    - **When PaO2 = 30mmHg then SaO2 = 60%**
    - **When PaO2 = 60mmHg then SaO2 = 90%**
  - **Acidosis- shift to the right**
  - **Alkalosis-shift to the left**
  - **pH needs to be within normal limits to facilitate oxygenation**

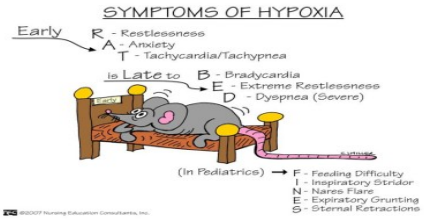
- **Oxygenation**
- **PaO2-≥70-SpO2 ≥94 Adequate**

PaO2-60-SpO2 90 Adequate

- **PaO2-55- SpO2 Adequate**
- **PaO2-40-SpO2 75 Adequate**
- **PaO2<40-SpO2<75 Inadequate**

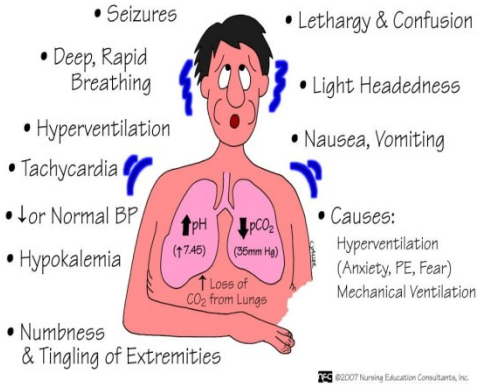
Clinical Manifestations of Hypoxia

- Rapid pulse
- Rapid shallow respirations & dyspnea
- Increased restlessness or lightheadedness
- Flaring of the nares
- Substernal or intercostal retractions
- Cyanosis
- Early-restlessness, dyspnea, low B/P, confusion, extreme fatigue, change in behavior (mood swing, disorientation, change in LOC), if cause is pneumonia cough & fever



- **Hypoxemia & Hypercapnia**
- **Respiratory acidosis & alkalosis**
- **Respiratory Failure (acute or chronic)**
  - Hypoxemic Respiratory Failure –oxygenation failure, PaO_2 ≤ 60 with FIO_2 ≥ 60%
  - Hypercapneic Respiratory Failure-ventilatory failure, $PaCO_2$ > 45 and pH < 7.35

RESPIRATORY ALKALOSIS



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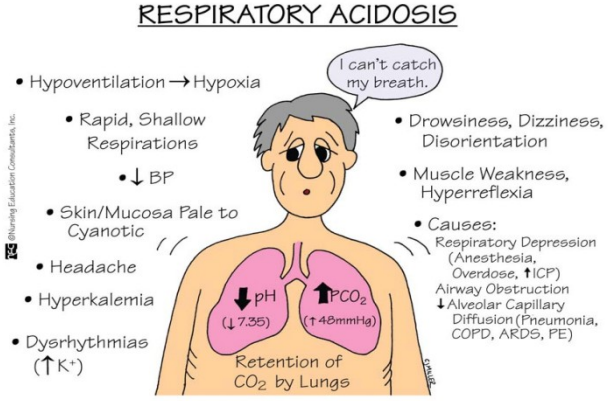

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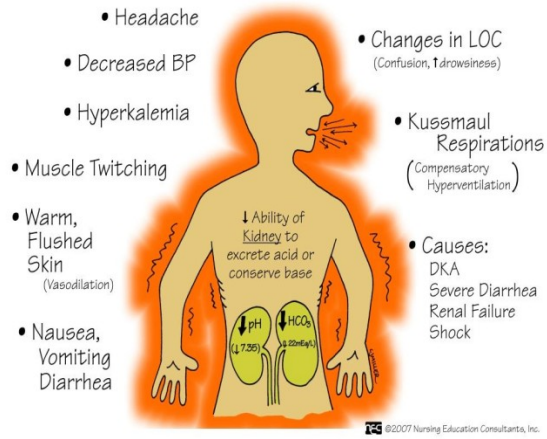
METABOLIC ACIDOSIS



METABOLIC ALKALOSIS