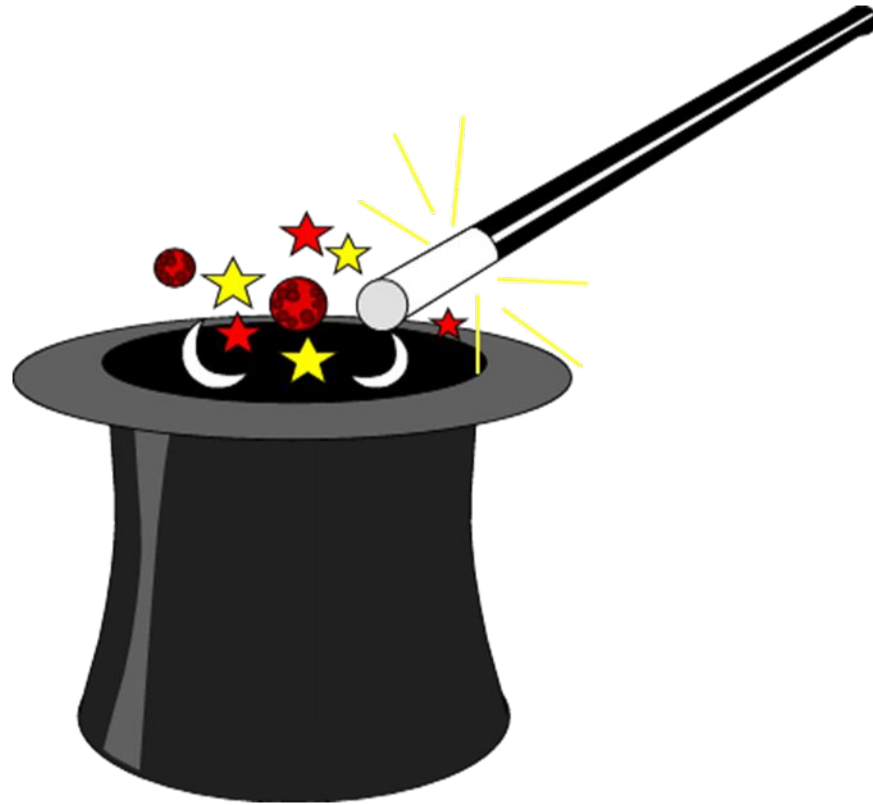




- **ABG CASE
STUDIES &
INTERPRETATION**

It's not magic understanding ABG's,
it just takes a little practice!



Acid-base imbalances

- Metabolic acidosis
- Metabolic alkalosis
- Respiratory acidosis
- Respiratory alkalosis

Metabolic

- **METABOLIC ACIDOSIS:** Decrease the HCO_3^- --> the pH goes down.
- **Compensation:** Respiratory Alkalosis (hyperventilation) will bring the pH back near normal.
- Causes: Diarrhea, DKA, LA, renal failure.
- **METABOLIC ALKALOSIS:** Increase the HCO_3^- --> the pH goes up.
- **Compensation:** Respiratory Acidosis (hypoventilation) can help to bring the pH+

Respiratory

- **RESPIRATORY ACIDOSIS**: Increase the PCO_2 ---> the pH goes down.
Hypoventilation. Compensation: **Metabolic Alkalosis** can help bring the pH back near normal.
- **Causes**: pneumonia, Bronchitis, Asthma
- **RESPIRATORY ALKALOSIS**: Decrease the PCO_2 -> the pH goes up.
Hyperventilation.
- **Compensation**: **Metabolic Acidosis** can
- help bring the pH back near normal.

METABOLIC ALKALOSIS

CAUSES:

- Vomiting: Lose enough stomach acid to produce alkalosis.
- Diuretics: Loop diuretics and thiazides can lead to hypokalemia -----> secondary metabolic alkalosis.
- Antacids overuse

RESPIRATORY ACIDOSIS:

causes:

CNS DEPRESSION

- DRUGS: Opiates, sedatives, anaesthetics
- OBESITY HYPOVENTILATION SYNDROME
- STROKE

NEUROMUSCULAR DISORDERS:

- NEUROLOGIC: POLIO, GBS, TETANUS, BOTULISM
- MUSCULAR DYSTROPHY

AIRWAY OBSTRUCTION

- ACUTE ASPIRATION, LARYNGOSPASM

CHEST WALL RESTRICTION

- PLEURAL: Effusions, empyema, pneumothorax, fibrothorax
- CHEST WALL: Kyphoscoliosis, scleroderma, ankylosing spondylitis, obesity

SEVERE PULMONARY RESTRICTIVE DISORDERS

PULMONARY FIBROSIS

RESPIRATORY ALKALOSIS

- **Causes:**
- High altitude.
- Neuromuscular disease
- Respiratory center depression
- Inadequate mechanical ventilation
- Sepsis
- Burns

Metabolic acidosis

- **Metabolic acidosis:** Is caused by a decrease in HCO_3^- concentration in blood.
- Causes:
 1. **Increased production of acids:** LA, kA, Salicylate poisoning.
 2. **Loss of HCO_3^- :** Diarrhea and kidneys RTA.
 3. **Blood profile:** pH decreased
 - $[\text{HCO}_3^-]$ decreased, PCO_2 decreased

Compensation of Metabolic acidosis:

- Respiratory compensation: decrease in pH stimulates respiratory center causing hyperventilation which produces decrease in PCO_2 .
- Renal Compensation: excess H^+ is excreted as titratable acid and NH_4^+ .
- Treatment: lactate containing solution which converts HCO_3^- ion the liver.

ABG Disorders

Disorder	Change	Compensation
Respiratory Acidosis	↑ Pa CO ₂	↑ HCO ₃ (Metabolic alkalosis)
Respiratory Alkalosis	↓ Pa CO ₂	↓ HCO ₃ (Metabolic acidosis)
Metabolic Acidosis	↓ HCO ₃	↓ Pa CO ₂ ↑ (Respiratory alkalosis)
Metabolic Alkalosis	↑ HCO ₃	↑ Pa CO ₂ (Respiratory acidosis)

Assessment of acid base status

- Direct arterial blood measurements: ABG

pH
pCO₂
pO₂

NB: use heparinised blood,
measured within 10 minutes

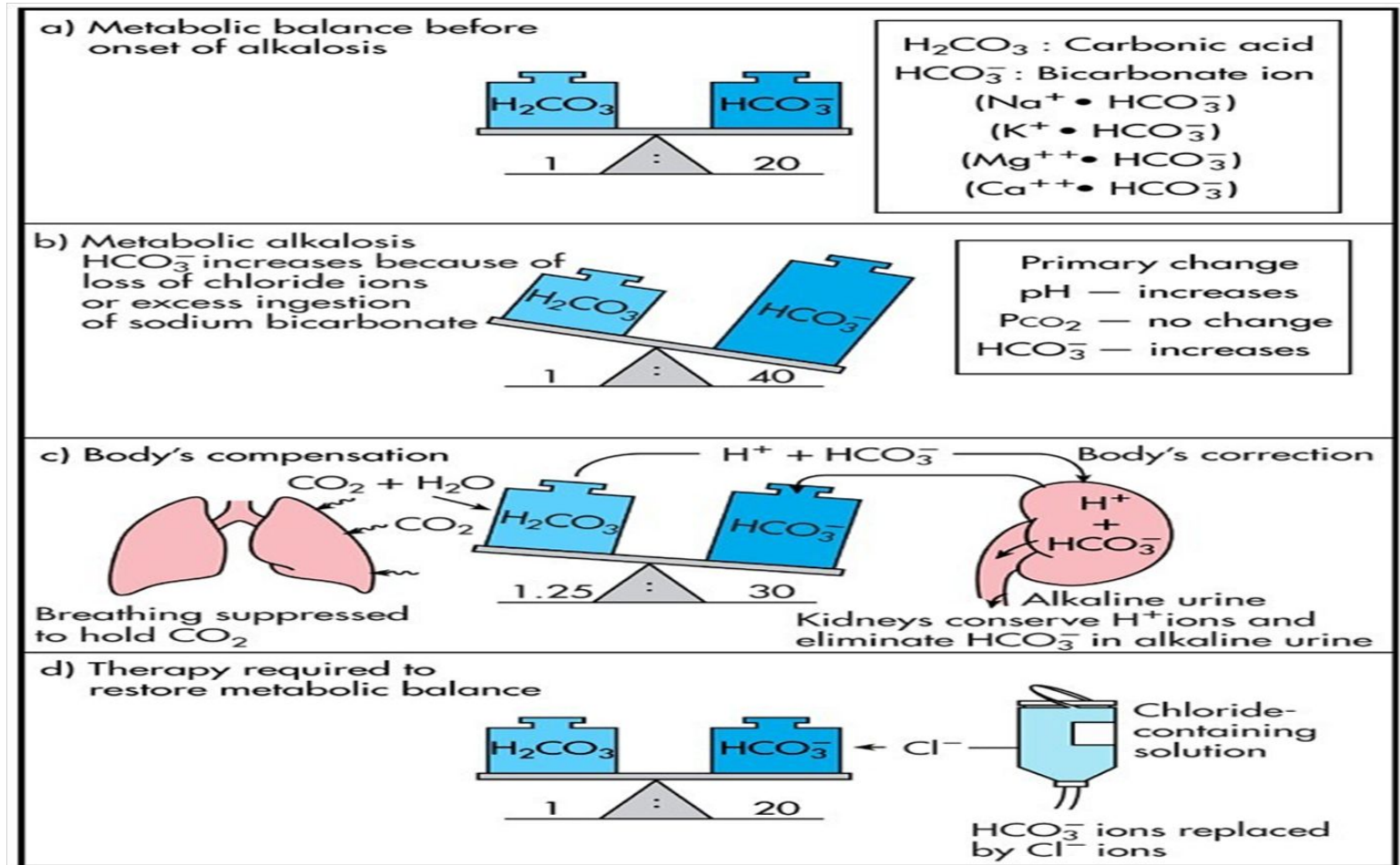
- Derived measures:

Bicarbonate (HCO₃⁻)

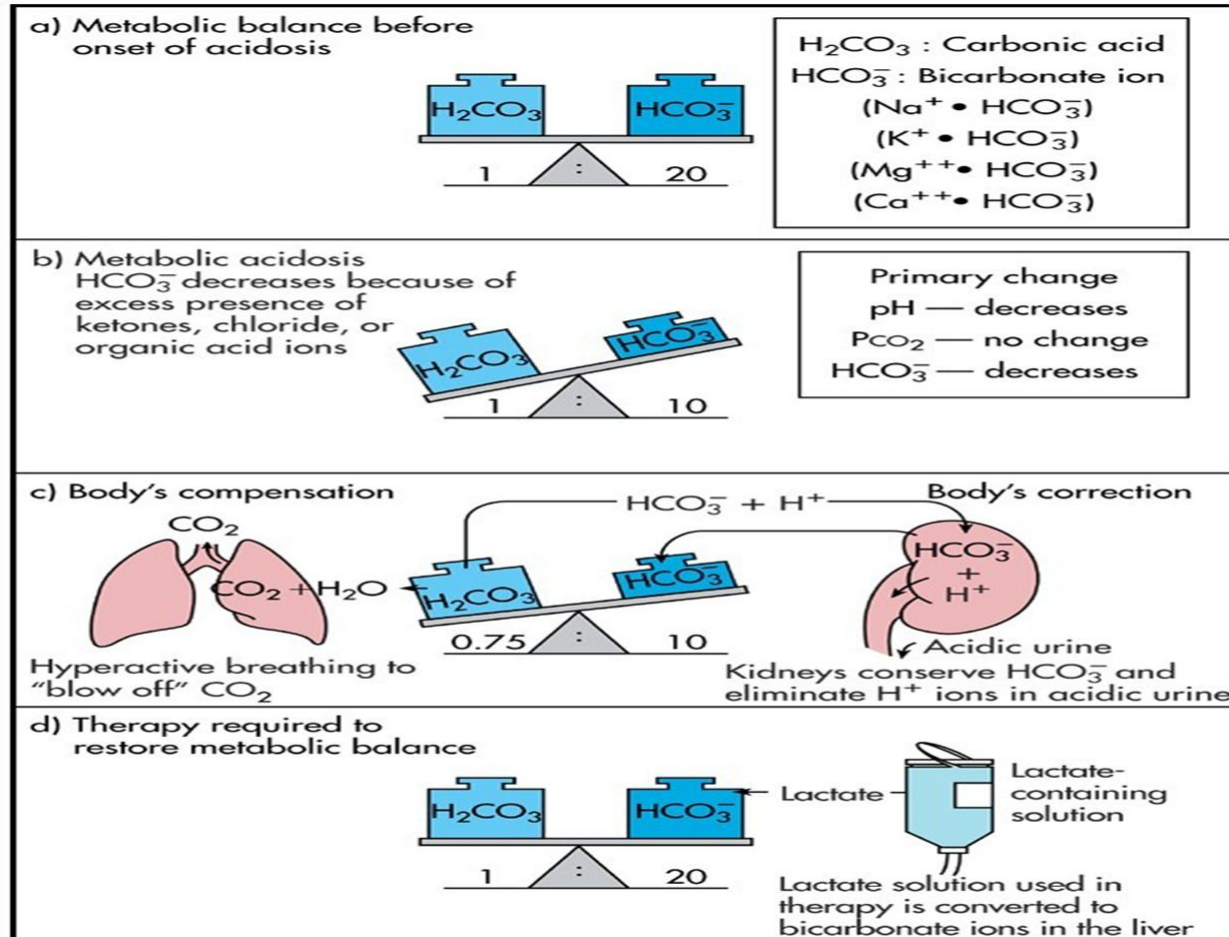
Normal Values:

pH = 7.35-7.45	(7.4)
HCO ₃ ⁻ = 22 - 26 mEq / L	(24 mEq / L)
pCO ₂ = 35 - 45 mm Hg	(40 mm Hg)

Metabolic alkalosis

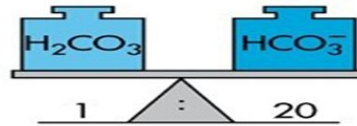


Metabolic acidosis



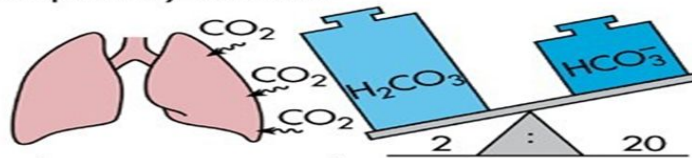
Respiratory acidosis

a) Metabolic balance before onset of acidosis



H_2CO_3 : Carbonic acid
 HCO_3^- : Bicarbonate ion
 ($Na^+ \bullet HCO_3^-$)
 ($K^+ \bullet HCO_3^-$)
 ($Mg^{++} \bullet HCO_3^-$)
 ($Ca^{++} \bullet HCO_3^-$)

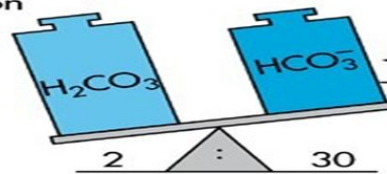
b) Respiratory acidosis



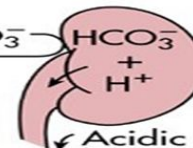
Breathing is suppressed, holding CO_2 in body

Primary change
 pH — decreases
 P_{CO_2} — increases
 HCO_3^- — no change

c) Body's compensation

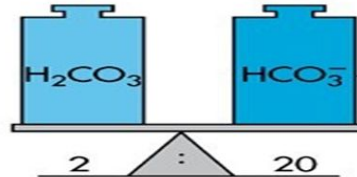


Body's correction
 H_2CO_3



Kidneys conserve HCO_3^- ions and eliminate H^+ ions in acidic urine

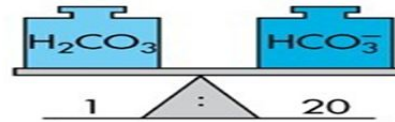
d) Therapy required to restore metabolic balance



Lactate solution used in therapy is converted to bicarbonate ions in the liver

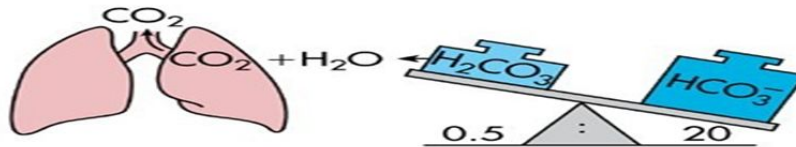
Respiratory Alkalosis

a) Metabolic balance before onset of alkalosis



H_2CO_3 : Carbonic acid
 HCO_3^- : Bicarbonate ion
 ($\text{Na}^+ \bullet \text{HCO}_3^-$)
 ($\text{K}^+ \bullet \text{HCO}_3^-$)
 ($\text{Mg}^{++} \bullet \text{HCO}_3^-$)
 ($\text{Ca}^{++} \bullet \text{HCO}_3^-$)

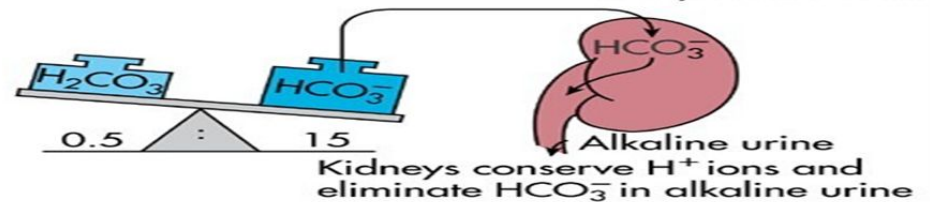
b) Respiratory alkalosis



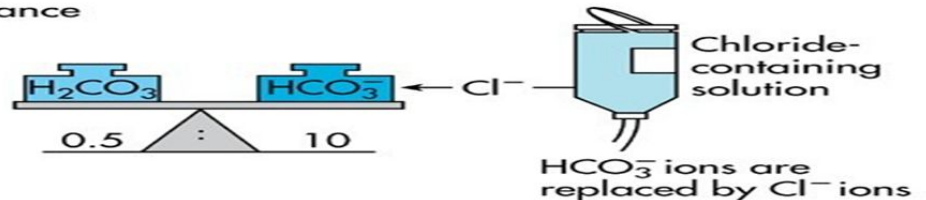
Hyperactive breathing
 "blows off" CO_2

Primary change
 pH — increases
 PCO_2 — decreases
 HCO_3^- — no change

c) Body's compensation



d) Therapy required to restore metabolic balance



Metabolic Acidosis

- pH 7.30
- PaCO₂ 40
- HCO₃ 15

Metabolic Alkalosis


- pH 7.50
- PCO₂ 40
- HCO₃ 30


Respiratory Acidosis

- pH 7.30
- PaCO₂ 60
- HCO₃ 26

Respiratory Alkalosis

- pH 7.50
- PaCO₂ 25
- HCO₃ 23

- 
- What are the compensations?
 - • Respiratory acidosis --metabolic alkalosis
 - • Respiratory alkalosis --metabolic acidosis
 - • In respiratory conditions, therefore, the kidneys will attempt to compensate and visa versa.

- 
- Buffers kick in within minutes.
 - **Respiratory compensation** is rapid and starts **within minutes** and complete within **24 hours**. **Kidney compensation** takes **hours** and up to **5 days**

Acid base disorder-worksheet

<u>Type of Disorder</u>	<u>pH</u>	<u>PaCO₂</u>	<u>[HCO₃]</u>
Metabolic Acidosis	↓		↓
Metabolic Alkalosis			
Respiratory Acidosis			
Respiratory Alkalosis			

Practice ABG's

pH 7.48	PaCO ₂ 32	HCO ₃ 24
pH 7.32	PaCO ₂ 48	HCO ₃ 25
pH 7.30	PaCO ₂ 40	HCO ₃ 18
pH 7.38	PaCO ₂ 48	HCO ₃ 28
pH 7.49	PaCO ₂ 40	HCO ₃ 30
pH 7.35	PaCO ₂ 48	HCO ₃ 27
pH 7.45	PaCO ₂ 47	HCO ₃ 29
pH 7.31	PaCO ₂ 38	HCO ₃ 15
pH 7.30	PaCO ₂ 50	HCO ₃ 24
pH 7.48	PaCO ₂ 40	HCO ₃ 30

Answers:

1. Respiratory alkalosis
2. Respiratory acidosis
3. Metabolic acidosis
4. Compensated Respiratory acidosis
5. Metabolic alkalosis
6. Compensated Respiratory acidosis
7. Compensated Metabolic alkalosis
8. Metabolic acidosis
9. Respiratory acidosis
10. Metabolic alkalosis

STEPS OF ASSESSING ABG

- *STEP 1:* Diagnose whether it is acidosis or alkalosis- (pH will help)
- *STEP 2:* Diagnose whether compensated or non compensated
- *STEP 3:* Diagnose whether it is metabolic or respiratory (Look at the value of bicarbonate and pCO₂)

Work sheet

- Diarrhea may lead to-----?
- Acid loss due to vomiting and gastric suction may lead to _____ alkalosis?
- Overuse of _____ may lead to metabolic alkalosis?

●

Problem#1



- 67 year female known diabetic for past 20years presented with sudden onset of severe chest pain and Shortness of breath.
- ABG analysis showed:
- pH 7.36
- PCO₂ 33 mmHg
- HCO₃ 18 mmol/L
- Discuss the probable diagnosis.

Problem #2

- A 30-year old man with DM presents with polyuria, polydipsia, fever, cough, and purulent sputum.
- His ABG shows the following Na⁺ 140 / Cl⁻ 104
K⁺ 7.0
- pH: 6.95
- pCO₂ : 33
- Hco₃ : 7.0
- Discuss the probable diagnosis.

Problem#3

- 45 year old male was admitted to the emergency room with complaints of mild vomiting, associated with disorientation and muscular weakness. His blood investigations showed the following
 - pH =7.20 Na -137meq/l
 - HCO₃⁻=16mEq / L Cl-108meq/l
 - pCO₂ = 34mm Hg K -5.8
 - Glucose=685mg/dl
 - urea49mg/dl

Problem #4

- 60 year male presents to the ED from a nursing home. You have no history other than he has been breathing rapidly and is less responsive than usual.

•
•
•
•

- Na⁺ 123 Cl⁻ 99 HCO₃⁻ 5
- pH 7.31 pCO₂ 10
- Discuss the probable diagnosis.

Problem # 5

- 60year old man was admitted with severe abdominal pain, which started some 2 hours back.
- Clinically he was in a state of shock with distended abdomen. Femoral pulses could not be palpable
- His ABG shows the follows pH : 7.05
- pCO₂: 26.3 mmHg
- HCO₃: 7 mmol/L Discuss the probable diagnosis.



***THANK YOU
FOR LISTENING!***