ABG Interpretation in critically ill patient

Practical Approach

Mohamad Radwan

July 6, 2017

Arterial Blood Gas Analysis

Key teaching objectives By the end of this session the candidate will:

- Be able to interpret simple arterial blood gas analyses in the context of cardiac arrest or impending cardiac arrest
- Have a systematic approach to arterial blood gas interpretation Know the meaning of common terms used in arterial blood gas interpretation
- Know the normal ranges for arterial blood gas values
- Know some of the common causes of arterial blood gas abnormalities and what to do to correct them

pH and Hydrogen Ion

$$pH = -log_{10}H^{+}$$

What do you look for when you analyse a blood gas sample?

- PO2
- PCO2
- pH (H+)
- Bicarbonate
- Base excess
- Lactate
- Sodium, Chloride ??

Oxygenation

- Alveolar Gas Equation:

$$p_AO_2 \approx F_IO_2(P_{ATM} - pH_2O) - \frac{PaCO_2}{RER}$$

- Simplified

$$p_AO_2 \approx (F_IO_2 * 5)$$

- $\frac{PO_2}{FiO_2}$ should be more than 250 at least
- SVO_2

Mixed venous oxygen saturation

LV *-i ll carry O2-* $\Rightarrow$ **Tissue** *-i will take O2 according to my needs or your flow-* $\Rightarrow$ **RV** *-going back again-*

- SVO_2 can help assess tissue oxygen delivery.
- Represents end oxygen saturation after tissues extract their requirement
- Oxygen delivery from the heart to tissues could be simplified to

$$DO_2 = CaO_2.CO$$

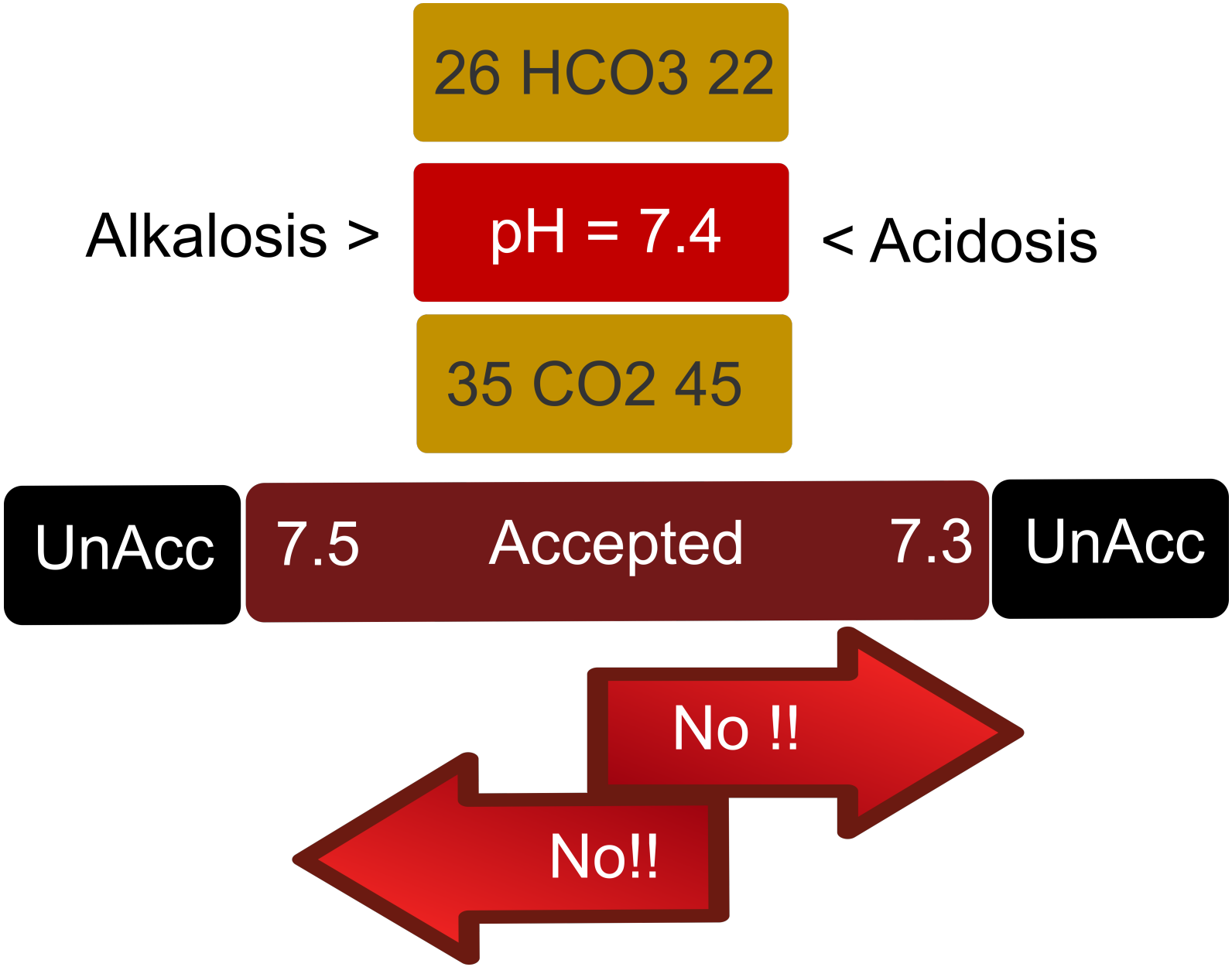
- CaO2 is depending on HB concentration and SPO_2
- Tissue extraction $= \frac{SPO_2 - SVO_2}{SPO_2}$
- Normal 65 to 75 percent
- Depends on demand and delivery

HH Equation

Bicorbonate Buffer System

$$pH = 6.1 + log_{10}\frac{HCO_3^-}{0.03.P_aCO_2}$$

- HCO_3 as metabolic representative; regulated by kidneys
- $PaCO_2$ as respiratory component; regulated by the lungs
- Hours VS Min


26 HCO3 22
Alkalosis >
pH = 7.4
< Acidosis
35 CO2 45
UnAcc
7.5
Accepted
7.3
UnAcc
No !!
No!!

Base excess

BE

The amount of strong acid that must be added to each liter of fully oxygenated blood to return the pH to 7.40 at a temperature of 37 C and a PCO_2 of 40 mmHg

- Dose to return E.C.F. to normal (mEq/L)
- usually for correction of metabolic component

Anion Gap

The Anion Gap (AG) is a derived variable primarily used for the evaluation of metabolic acidosis to determine the presence of unmeasured anions

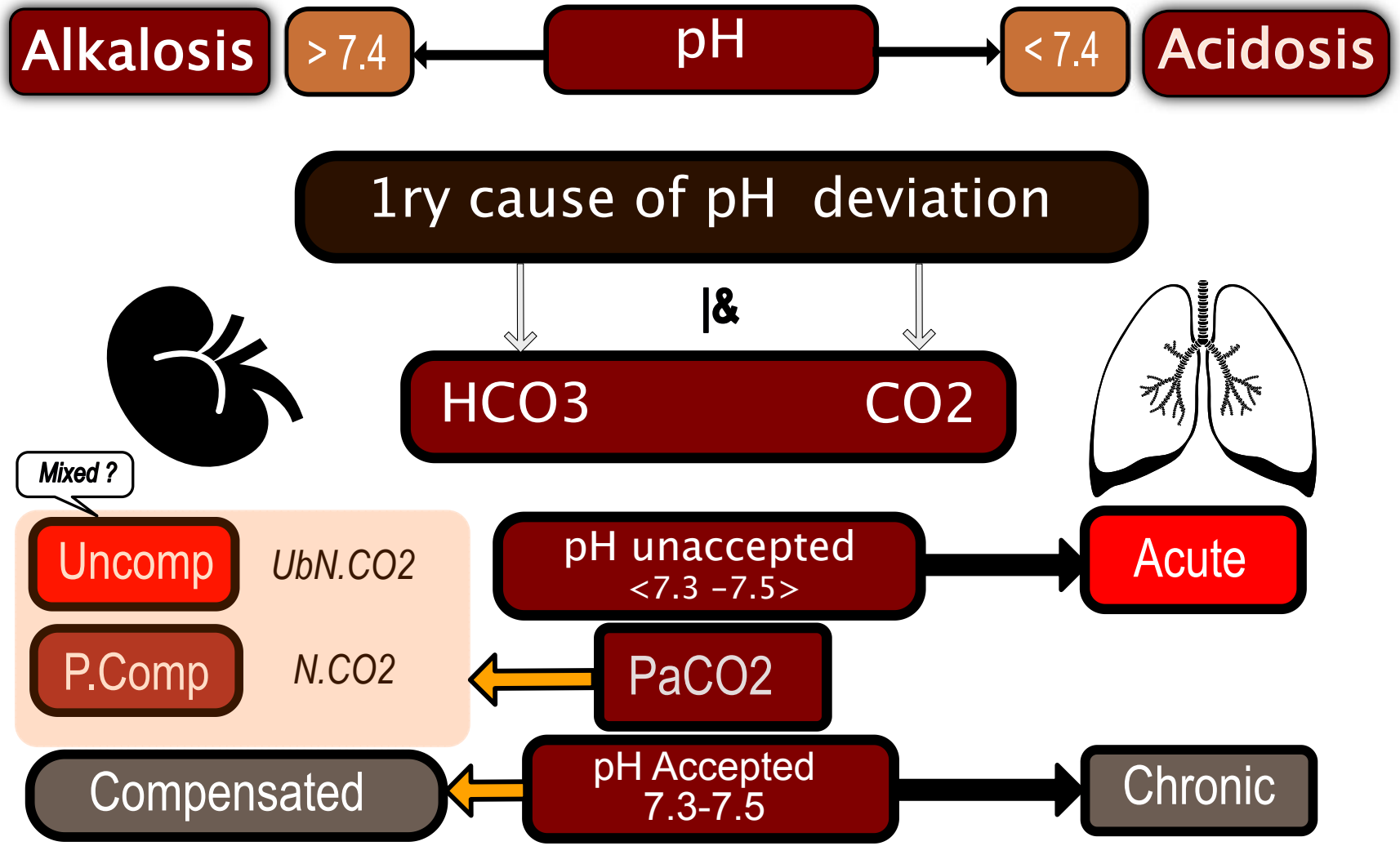
$$AnionGap = Na^{+} - (Cl^{-} + HCO_3^{-})$$

Normal Anion Gap Metabolic Acidosis

- Hypercholermic Acidosis, RTA

High anion Gap Metabolic Acidosis

- DKA
- Lactic
- Renal Failure
- Toxins


Alkalosis
> 7.4
pH
< 7.4
Acidosis
1ry cause of pH deviation
|&
HCO3
CO2
Mixed ?
Uncomp
UbN.CO2
P.Comp
N.CO2
pH unaccepted
<7.3 -7.5>
Acute
PaCO2
Compensated
pH Accepted
7.3-7.5
Chronic

Scenario 1

Initial Information

- A 75 year old man presents to the accident and emergency department after a witnessed out of hospital VF cardiac arrest. The paramedics arrived after 10 minutes, during which CPR had not been attempted. The paramedics had successfully restored spontaneous circulation after 6 shocks.
- On arrival the man is comatose with a GCS of 3 and his lungs are being ventilated with 50% oxygen via a tracheal tube. He is in a sinus tachycardia with rate of 120 min-1 and a blood pressure of 150/95 mmHg

Predictions ??

Scenario 1

Arterial blood gas analysis reveals:

- FiO2 0.5
- pH 7.07
- $PaCO_2$ 50 mmHg
- PaO_2 56 mmHg
- $HCO3^-$ 14 mmol $/^{-1}$
- BE -10 mmol$/^{-1}$

Scenario 2

Initial Information

- A 75 year old woman is admitted to the accident and emergency department following a VF cardiac arrest, which was witnessed by the paramedics. This had been preceded by 30 minutes of severe central chest pain.
- A spontaneous circulation was restored after 4 shocks, but the patient remained comatose and apnoeic. The paramedics intubated her trachea, and on arrival in hospital her lungs are being ventilated with an automatic ventilator using a tidal volume of 900 ml and a rate of 18 breaths min^{-1}.

Predictions ??

Scenario 2

Arterial blood gas analysis reveals:

- FiO2 1.00
- *pH* 7.60
- $PaCO_2$ 20 mmHg
- PaO_2 192 mmHg
- $HCO3^-$ 20 mmol l-1
- *BE* -4 mmol l-1

Scenario 3

Initial Information

- An 18 year old male who is an insulin dependent diabetic is admitted to the accident and emergency department. He has had been vomiting for 48 hours and because he was unable to eat, he chose to omit his insulin.
- He is in a sinus tachycardia at a rate of 130 min-1 and his blood pressure is 90/65 mmHg. He is breathing spontaneously with deep breaths at a rate of 35 min-1 and is receiving oxygen 4 l min-1 via . His GCS is 12

Scenario 3 (continued)

- FiO2 1.00
- *pH* 6.79
- $PaCO_2$ 11 mmHg
- PaO_2 129 mmHg
- $HCO3^-$ 4.7 mmol l-1
- *BE* -29 mmol l-1

The blood glucose is 30 mmol l-1 and there are ketones+++ in the urine

Scenario 5

let us sum all ..