18th International Congress of Anesthesiology, Critical Care and Pain

Trauma related Fluid and blood therapy changes in acid-base balance

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18–20 November 2026 · Tehran, Iran · From Innovation to Resilience

Neutral pH for pure water=7.0

Physiologic pH for the ECF=7.4

pH of intracellular space=6.8-7

pH of arterial blood=7.4

pH of venous blood=7.35

Water becomes alkaline with falling

temperature and acidic with increasing temperature

Water is a highly ionizing solution substances with polar bonds dissociate into their component parts (dissolve) in water Strong electrolytes: are always completely dissociated in solution strong ions Weak electrolytes: only partly dissociate solution weak ions Strong ions: Na+, K+, Mg++, Ca++, Cl-, SO42-

Weak ions: albumin, phosphate, bicarbonate

SID

- SID indicates the amount by which the strong cations are in excess of the strong anions
- It is an indication of measured and unmeasured anions in the ECF
- SID independently influences water dissociation
- In ECF: $[OH^-]$ always exceeds $[H^+]$

Main causes of benign acidosis

- Any process that increases Cl^- without Na^+ RTA (hyperchloremic acidosis)
- Severe diarrhea loss of Na^+ and K^+ SID (Dilutional metabolic acidosis)
- Excessive administration of saline, parenteral nutrition, use of CAIs

Sinister Acidosis

- Most malignant form of metabolic acidosis: net gain of unmeasured anoins:
  - Lactate (dysoxia and severe stress)
  - Ketoacids (β-hydroxybutyrate and acetoacetate)
  - SO_4^{2-} and PO_4^{3-} (fixed renal acids) in severe RF

Changes of HCO3 versus PaCO2

Table 49-1 -- Changes in $Paco_2$ and [HCO_3^-] in Response to Acute and Chronic Acid-Base Disturbances

Disturbances	[HCO_3^-] versus $Paco_2$
Acute respiratory acidosis	$\Delta HCO_3^- = 0.2\ \Delta Paco_2$
Acute respiratory alkalosis	$\Delta HCO_3^- = 0.2\ \Delta Paco_2$
Chronic respiratory acidosis	$\Delta HCO_3^- = 0.5\ \Delta Paco_2$
Metabolic acidosis	$\Delta Paco_2 = 1.3\ \Delta HCO_3^-$
Metabolic alkalosis	$\Delta Paco_2 = 0.75\ \Delta HCO_3^-$

Changes of BDE versus PaCo2

Disturbance	BDE versus $Paco_2$
Acute respiratory acidosis	$\Delta BDE = 0$
Acute respiratory alkalosis	$\Delta BDE = 0$
Chronic respiratory acidosis	$\Delta BDE = 0.4\ \Delta Paco_2$
Metabolic acidosis	$\Delta Paco_2 = \Delta BDE$
Metabolic alkalosis	$\Delta Paco_2 = 0.6\ \Delta BDE$

Size of Contribution to PH

- Every 10 mmHg in PCO2 = 0.08 change in PH
- Every 10 mEq/l in HCO3 = 0.16 change in PH
- Every 10 mEq/L in BE = 0.16 change in PH

Case1

- PH=7.33 PCO2=50
- BE= 0 HCO3=26
- Acute respiratory acidosis

Case2

- PH=7.46 PCO2=30
- BE=0 HCO3=22
- Acute respiratory alkalosis

Case 3

- **PH=7.38 PCO2= 50**
- **BE= 4 HCO3= 28**

Renal compensation happened

- Chronic respiratory Acidosis

Case4

- PH=7.42 (7.48) PCO2=30
- BE= -4 HCO3= 21
- Renal compensation happened
- Chronic respiratory alkalosis

Three independent variable

- PCO2
- SID=SUM OF CATIONS –ANIONS (40)
- TOTAL WEAK ACIDS[alb,phos]

Type of colloids

- Each unit PC contains 4-5 meq citrate which converted to 8-10 meq bicarbonate by liver

- Each unit PC contains about 5 meq lactate which is converted to bicarbonate by liver

- Each unit of PC change BE about +1.

- Albumin has negative charge and lead to metabolic acidosis
- Each unit albumin 5% contains 12.5 gram albumin
- Each litter of blood contains 35-40 gram albumin (4 gr per dl)
- If you give 1 liter albumin 5% to a 70 kg person , BE change about -2.5.
- Hetstarch is the same as NS in terms of Acid-Base. (6% hydroxyethylstarch in NS)

Crystalloids

- Each liter of normal saline give 54 meq excess chloride
- Each liter of NS change BE about -3. (hyperchloremic metabolic acidosis)
- Each unite of LR contains about 28 meq lactate.
- 28 meq lactate converted to 28 meq bicarbonate by the liver
- Bicarbonate distribute in the extracellular fluid (15 Litre)

- Each liter of LR changes BE about +2.
- Dextrose 5% is in fact pure water and dilute plasma.
- Dextrose/saline is the same as dextrose 5%.
- Each liter of Dextrose 5% change BE about -5 instantly but after equilibrium BE change decrease to about -2.

