Hypo-Bicarbonate

Note

Bicarbonate $HCO3^-$ Deficit Equation:

Desired serum $HCO3^-$ - Measured *0.5* Body Weight (volume of distribution) = Deficit/Litre

Primary Metabolic Acidosis

(PH < 7.35 & Serum $HCO3^-$ < 24mEq/L)

Respiratory Alkalosis

Causes: Reduction in PCO2 due to Hyperventilation (1)
Treatment: Causes of hypoxia should be identified and treated. In mechanically ventilated patients, minute ventilation should be decreased by decreasing the respiratory rate and/or tidal volume. In psychogenic hyperventilation, reassurance and anxiolytics can be used. In patients at high altitudes, acetazolamide can be used to induce a metabolic acidosis to compensate for the respiratory alkalosis. (2)

Metabolic Acidosis

Anion Gap: $Na+ – Cl^- + HCO3^-$

AG > 12 mmol, every increase in AG by 1 mmol/L decreases serum $HCO3^-$ by equal amount

High Anion Gap (> 12mEq/L)

Diabetic Ketoacidosis (2)

Cause: Insulin deficiency
Symptoms: Vomiting, abdominal pain & dehydration
Treatment:
-Insulin treatment + BGL monitoring.
-Fluid management
-Electrolyte management $HCO3^-$ given

1) Severe acidosis with pH <7 stopped once the pH is >7.1
2) Severe loss of buffering capacity <5–10 mEq/L
3) Acidosis induced cardiac or respiratory distress
4) Severe hyperkalemia

Methanol Toxicity (2)

(Minimal lethal dose 50-100ml)
Symptoms: Weakness, headache & blurred vision.
Prompt treatment: Oral charcoal & NaHCO3

Salicylate Toxicity (2)

(Therapeutic= 20-35mg/dl)
Cause: Plasma level > 40-50mg/dl increases ketoacid & lactate production.
Treatment:
-Reduce salicylate levels.
-Alkalinization of plasma to a pH > 7.45.

Propylene Glycol toxicity (2)

Cause: It is used as vehicle in lorazepam and others.
It is converted to pyruvate then lactate.
Treatment: Discontinue infusion

Normal Anion Gap (8-12mEq/L)

Urine Anion Gap (UAG) discern source of $HCO3^-$ loss

UAG= Urine Na+ **+** Urine K+ **-** Urine Cl^-

Normally zero or slightly positive

Renal

(UAG +ve)

Non Renal

(UAG= -20 to -50 mEq/L)
Due to increase in ammonium chloride excretion

Ethylene Glycol Toxicity (2)

Component of antifreeze and solvents.

Symptoms: Neurologic and cardiopulmonary abnormalities, flank pain, and renal failure.

Needle shaped oxalate crystals in urine.

Treatment:

-Administration of ethanol or fomepizole

-Administration of folic acid, thiamine, and pyridoxine.

-Hemodialysis for removal of toxic metabolites and parent compound.

Lactic Acidosis (2)

Cause: Increase in lactate production or Decrease in lactate utilization.

Treatment:

-Correction of the underlying disorder & reversal of circulatory failure is the 1ry therapy.

-$NaHCO_3$ administration indicated if severe acidosis pH <7.1 or loss of buffering capacity (HCO_3<5 mEq/L).

-Hemodialysis may be indicated in resistant cases.

-Alternative therapies:

Carbicarb: equimolar mixture of sodium carbonate and sodium bicarbonate.

Dichloroacetate: activates pyruvate dehydrogenase and increases oxidation of pyruvate.

Renal **(2)**

(UAG +ve)

	Distal (RTA Type 1)	Proximal (RTA Type 2)	Hyporeninemic/ Hypoaldosteronism (RTA Type 4)
Cause	• Idiopathic • Familial • Sjogren syndrome • Hypercalciuria, • RA, • SCA, • Amphotericin	• Idiopathic, • Multiple myeloma • Carbonic anhydrase inhibitor • Heavy metals • Hypocalcemia, • Vit D deficiency	• Diabetes • ACE inhibitor • Tubulointerstitial nephritis NSAIDS • Heparin • Adrenal insufficiency (Obstrucuropathy) • K+sparing diuretics
Defect	Impaired distal tubule H+ excretion	Impaired proximal tubule HCO_3^- absorption +/- glycosuria, aminoaciduria, phosphaturia	Aldosterone deficiency/ resistance
Plasma HCO_3^-	Variable; usually severe < 10 mEq/L	Less severe, 12-20 mEq/L	> 15 mEq/L
Urine PH	> 5.3	> 5.3 if serum HCO_3^- above reabsorptive threshold < 5.3 if serum HCO_3^- below reabsorptive threshold	< 5.3

Plasma K+	Low	Low	High
UAG	+ve	Variable	+ve
Associated Condition	Renal stones	• Rickets • Osteomalacia • Fanconi syndrome	None
Treatment	Alkali therapy	Alkali therapy or Thiazide (in resistant cases)	Treat the cause

Note

IV HCO3 (1)

Isotonic sodium bicarbonate 1.26%. (HCO_3^- =150 & Na+ = 150)

Hypertonic sodium bicarbonate 8.4%. (HCO_3^- =1000 & Na+ = 1000)

-Isotonic (1.26%) sodium bicarbonate may be used to correct acidosis associated with renal failure or to induce a forced alkaline diuresis.

-The hypertonic (8.4%) solution (1mEq HCO_3^- /mL) is rarely required in intensive care practice to raise blood pH in severe metabolic acidosis.

-Excessive administration may cause hyperosmolality, hypernatraemia, hypokalaemia & sodium overload.

-Fluid and potassium deficit should be corrected first.

- Both arterial and venous values should be monitored. (2)

-Continuous or intermittent hemodialysis may also be used to correct severe, refractory acidosis (2)

-In the setting of a combined metabolic and respiratory acidosis, correction of the respiratory acidosis component should be addressed prior to administration of bicarbonate or initiation of hemodialysis.-threatening acidosis. (2)

References:

(1) Oxford Handbook of Critical Care 3rd edition

(2) Washington Manual of Critical Care