Treating Acid Base Disturbances and Correcting Electrolyte Abnormalities

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Metabolic Acidosis

Sodium Bicarbonate:

- **Indication**: pH < 7.1 or severe acidosis with renal failure.
- Normal pH 7.35-7.45
- **Dose**: 1–2 mEq/kg IV bolus, or continuous infusion (150 mEq in 1L D5W at 100–200 mL/hr) titrated to effect (Kraut & Madias, 2010).
- Calculate the base deficit = .3 (BE) *(Ideal body wt)/ 50 meq per amp

Renal Replacement Therapy (RRT):

- **Indication**: Refractory acidosis or renal failure.
- **Mode**: CRRT or intermittent hemodialysis.

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Metabolic Alkalosis

Normal Saline (0.9% NaCl):

- **Indication**: Chloride-responsive alkalosis (e.g., vomiting, diuretics).
- **Dose**: 1–2 L IV bolus followed by maintenance rate as needed.

Potassium Chloride (KCl):

- **Dose**: Oral 40–100 mEq/day or IV 10–20 mEq/hr, max 40 mEq/hr via central line with cardiac monitoring.

Acetazolamide:

- **Indication**: Volume overload with alkalosis.
- **Dose**: 250–500 mg IV or PO once or BID.

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Respiratory Acidosis

Noninvasive Ventilation (BiPAP) or **Intubation**:

- Indicated based on mental status, respiratory effort, and gas exchange.
- HP<7.2

Naloxone (if opioid-related):

- **Dose**: 0.04–0.4 mg IV, titrate to respiratory response.

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Respiratory Alkalosis

Benzodiazepines (e.g., lorazepam):

- **Dose**: 1–2 mg IV/PO as needed for anxiety-induced hyperventilation.
- pH >7.45

Treat underlying cause (e.g., antibiotics for sepsis).

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pH Range and Associated Mortality Risk

pH Range	Clinical Interpretation	Associated Mortality Risk	Key Clinical Concerns
< 7.00	Severe Acidemia	> 80%	Cardiovascular collapse, arrhythmias, impaired contractility
7.00 – 7.19	Moderate to Severe Acidemia	50–60%	High lactate, shock, poor tissue perfusion
7.20 – 7.34	Mild Acidemia	20–30%	Often in sepsis, renal failure
7.35 – 7.45	Normal	< 5%	Optimal physiologic range
7.46 – 7.54	Mild Alkalemia	10–15%	May be asymptomatic or early compensatory response
7.55 – 7.59	Moderate Alkalemia	20–35%	Arrhythmias, hypokalemia, hypoventilation
≥ 7.60	Severe Alkalemia	> 45–50%	Cerebral vasoconstriction, seizures, decreased coronary perfusion

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Sodium

Hyponatremia

3% Hypertonic Saline:

- **Indication**: Severe or symptomatic hyponatremia (Na^+ < 120 mEq/L with seizures or confusion).
- **Dose**: 100 mL IV over 10 min × 3 doses PRN, then infusion 0.5–2 mL/kg/hr.
- **Correction goal**: ≤10 mEq/L per 24 hours (Sterns et al., 2022).

Tolvaptan (SIADH, euvolemic hyponatremia):

- **Dose**: 15 mg PO daily, titrate to 30–60 mg/day.

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Sodium

Hypernatremia

D5W or 0.45% NaCl:

- **Dose**: Free water deficit = 0.6 × weight (kg) × [(serum Na^+ / 140) – 1]; replace over 48–72 hours.

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Potassium

Hypokalemia

Oral Potassium Chloride:

- **Dose**: 20–40 mEq PO BID-TID; max 100 mEq/day.

IV Potassium Chloride:

- **Dose**: 10–20 mEq/hr via peripheral line; up to 40 mEq/hr via central line with telemetry.

Magnesium Sulfate (if concurrent hypomagnesemia):

- **Dose**: 1–2 g IV over 1 hour, repeat as needed.

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Potassium

Hyperkalemia

Calcium Gluconate 10%:

- **Dose**: 10 mL IV over 5–10 min; may repeat every 30–60 minutes.

Insulin + Dextrose:

- **Dose**: Regular insulin 10 units IV + 25–50 mL of D50W over 5 minutes.

Albuterol:

- **Dose**: 10–20 mg nebulized over 10 minutes.

Sodium Bicarbonate (if metabolic acidosis):

- **Dose**: 50–100 mEq IV over 5–10 minutes.

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Potassium

Hyperkalemia (Cont.)

Furosemide:

- **Dose**: 20–40 mg IV; titrate for diuresis.

Sodium Polystyrene Sulfonate (Kayexalate):

- **Dose**: 15–30 g PO/PR; avoid in ileus or post-op.

Dialysis:

- Indicated in refractory or renal failure-associated hyperkalemia.

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Calcium

Hypocalcemia

Calcium Gluconate:

- **Dose**: 1–2 g IV over 10–20 minutes; repeat PRN.

Calcium Chloride (for severe/symptomatic cases):

- **Dose**: 1 g IV over 10 minutes via central line only.

Vitamin D (Calcitriol):

- **Dose**: 0.25–1 mcg PO daily for chronic hypocalcemia or renal disease.

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Calcium

Hypercalcemia

Normal Saline IV:

- **Dose**: 200–300 mL/hr for volume repletion.

Furosemide (after rehydration):

- **Dose**: 20–40 mg IV every 12 hours.

Calcitonin:

- **Dose**: 4 IU/kg SC or IM q12h; effect in 4–6 hours.

Zoledronic Acid (bisphosphonate):

- **Dose**: 4 mg IV over 15 minutes, single dose.

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Magnesium

Hypomagnesemia

Magnesium Sulfate:

- **Mild (Mg^{2+} 1.2–1.7 mg/dL)**: 1–2 g IV over 1–2 hours.
- **Severe (<1.2 mg/dL or seizures/arrhythmia)**: 4–6 g IV over 4–12 hours.

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Magnesium

Hypermagnesemia

Calcium Gluconate 10%:

- **Dose**: 1–2 g IV over 10 minutes to reverse cardiac/muscular effects.

Loop diuretics + IV fluids to enhance renal excretion.

Dialysis if anuric or severe toxicity.

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Phosphate

Hypophosphatemia

Oral phosphate (Neutra-Phos):

- **Dose**: 250 mg PO BID-TID.

IV Sodium or Potassium Phosphate:

- **Mild (2.0–2.5 mg/dL)**: 0.08–0.16 mmol/kg IV.
- **Severe (<1.0 mg/dL)**: 0.32–0.64 mmol/kg IV over 4–6 hours.
- Kphos 10-30 mmol = (30-90 meqK+)

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Phosphate

Hyperphosphatemia

Sevelamer (Renvela):

- **Dose**: 800–1600 mg PO TID with meals.

Calcium Acetate:

- **Dose**: 667 mg PO TID with meals.

Dialysis if refractory or ESRD.

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Best Practice Recommendations

Use a **systematic approach**: Assess volume status, acid-base status, and electrolyte trends.

Correct coexisting abnormalities simultaneously (e.g., Mg and K).

Avoid overcorrection: Follow published correction limits to prevent iatrogenic harm.

Consider **consultation with nephrology or critical care** in complex cases.

Regular monitoring: Electrolytes, ABG, renal function every 4–6 hours in unstable patients.

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