# Nutrition Support in the Hospitalized Patient

Phil Ayers, Pharm.D., BCNSP
Baptist Health Systems
Jackson, Mississippi
Assistant Clinical Professor
University of Mississippi

## Financial Disclosure

- Baxter

## Objectives

- Describe methods to calculate the nutritional needs of the hospitalized patient
- Discuss the role of parenteral nutrition and how to write the prescription
- Explain methods to replace/manage electrolytes and the importance of acid-base principles

## Adult Caloric Needs

- 20-35kcal/kg
- Harris-Benedict
- Indirect Calorimetry
  - RQ
  - REE

JPEN. 2002;26:1SA-138SA.

## Adult Protein Needs

- 0.8g/kg normal
- 1-1.5g/kg stressed
- 2-3g/kg burn/hypermetabolic
- 0.6g-0.8g/kg Chronic RF Non Dialysis
- 1.2-1.3g/kg  Chronic RF Dialysis-HD,PD
- CRRT 1.5-2.5g/kg

JPEN, 2002;26:1SA-138SA.

CCM, 2009; vol37, 5

## Energy Needs Peds

- 0-1 years  90-120kcal/kg
- 1-7 years  75-90kcal/kg
- 7-12 years  60-75kcal/kg
- 12-18 years  30-60kcal/kg
- >18 years  25-35kcal/kg

JPEN. 2002;26:1SA-138SA.

## Protein Requirements Peds

- Low birth/kg/d wt 3-4g/kg/d
- Full term 2-3g/kg/d
- 1-10 years 1-1.2g/kg/d
- Adolescence
  - Boys 0.9g/kg/d
  - Girls 0.8g/kg/d
- Critically Ill 1.5g/kg/d

JPEN. 2002;26:1SA-138SA.

## Patient Selection
## Indications for Parenteral Nutrition

- Cannot eat adequately or should not eat to maintain adequate nutrition status.
- Malnourished or at risk of malnutrition from inadequate nutrient intake for ≥7 days or weight loss ≥10% preillness weight.
- Enteral feedings have failed or are contraindicated.
- Have severely diminished intestinal function due to underlying diseases (obstruction, short bowel syndrome, ileus, peritonitis).

## Patient Selection
## Peripheral vs. Central

Peripheral

- Short-term (< 2 weeks)
- Adequate peripheral venous access
- Central venous access not feasible
- Moderate nutrient needs
- No fluid restrictions

Central

- Required for ≥ 2 weeks
- Limited peripheral venous access
- Large nutrient needs
- Require fluid restrictions

## Dextrose

- Carbohydrate (d-glucose monohydrate)
- 3.4 kcals/g
- Commercially available 2.5%-70%
- Osmolarity ≈ 5 mOsm/g
  - (gm dextrose X 5) = mOsm/L
  - volume (L)

## Amino Acids

- Protein/nitrogen
- 4.0 kcals/g
- Products available
  - standard: balanced essential/non-essential AA
  - specialty: AA modified for disease/special states
- Vary in electrolyte composition
- Vary slightly in nitrogen content
  (≈1g N/6.3 g AA)
- Osmolarity ≈10 mOsm/g
  (g amino acids X10) = mOsm/L
  volume (L)

## Lipid Emulsions

- ≈10 kcals/g
- Soybean or safflower/soybean emulsions
  - Long-chain fatty acids -essential fatty acids
  - Egg phosphotides emulsifier
  - Glycerol to adjust osmolarity
- Osmolarity
  - 10%, 20% isotonic
  - 30% hypotonic
- Contains phosphorus as phospholipids
- Mixtures of long-chain/medium-chain triglycerides not available in US

## Recommendations for Daily IV Vitamins

| Vitamin | AMA/NIH | FDA |
|---|---|---|
| | | 6 mg |
| | | 0.64 mg |
| | | 200 mg |
| | | 60 mcg |

## Vitamins

- Vitamin K
  - not in 12-vitamin products
  - included in the new 13-vitamin products
  - some in IV lipids-amount not standardized
    - 10% - 13-30 mcg/100 mL
    - 20% - 27-68 mcg/100 ml
  - if using 12-vitamin profile must supplement
    - 2-4 mg/week
    - 250-500 mcg/d IV

## Recommended Daily Intake of Intravenous Trace Minerals

| Trace Element | Dose |
|---|---|
| Chromium | 10-15 mcg |
| Copper | 0.3-0.5 mg |
| Manganese | 60-100 mcg |
| Zinc | 2.5-5.0 mg |

## Trace Minerals

- Combination products; single entities
- Other trace minerals
  - Selenium 20-60 mcg/d
  - Iron
  - Molybdenum
  - Iodine

## L-Glutamine

- Not included in commercially available AA products - ? need; instability in solution
- Mixed with other AA
- Not commercially available
- Provided by few home infusion companies
- Doses 0.18-0.57 g/kg/d; usually ≤ 40 g/d

## Standard Parenteral Formulations

**Peripheral**

- Low nutrient density
- Dextrose ≤10%, 30-40% kcals
- AA 3-5%
- Lipid 60-70% kcals
- Osmolarity <900

**Central**

- Increased nutrient density
- Dextrose 15-30%, 60-70% kcals
- AA 5-10%
- Lipids 30-40% kcals
- Osmolarity ≥1800

## Writing the Rx

60 yo male with psbo, normal renal and hepatic function. NPO > 7 days.
Height 69 " Weight 65kg. PICC placed

TPN to provide:

1.5g/kg protein

25 kcal/kg

## Writing the Rx

1.5g/kg/day protein x 65kg = 97.5g = 98g

25 kcal/kg/day x 65kg = 1625kcal

98g x 4kcal/g = 392 kcal

Non Protein kcal = 1233 kcal

1625 kcal/day

30 % total kcal from lipids= 490kcal

## Writing the Rx

980 mls 10% Amino Acids (98g)

310 mls 70% Dextrose (743kcal/3.4g/kcal)

(218g/x =70g/100ml=312mls)

245 mls 20% Lipids (2kcal/ml - 490 kcal)

1535 mls 392 Protein Calories

1228 Non-Protein Calories

64mls/hr

65kg x 30mls/day = 1950 mls/day

## Writing the Rx

Premix Products:

4.25/10 (42.5g/l Protein 100g/l Dextrose)

42.5g/l = 98g/x = 2.3 liters 392 kcal/d

100g/l = x/2.3 l = 230g Dex. = 782 kcal/d

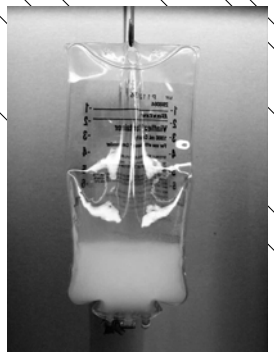
1174 kcal/d

225mls 20% lipids 450kcal/d

## Stability of PN Formulations General Considerations

- Temperature
- pH
- Exposure to light
- Time
- Composition
- Order components are admixed

## Calcium Phosphate Precipitation



# Factors Enhancing Calcium Phosphate Solubility

- Low molar calcium and phosphate salt concentrations
- Low pH (acidic) of formulation
- Higher amino acid concentration
- Cool environmental temperature
- Addition of phosphate before calcium
- Avoid prolonged standing time or slow infusions
- Use calcium gluconate (avoid chloride)

# Calcium/Phosphate Equation

**To calculate must determine Ca/Phos/Liter**

**980 cc 10% A.A., 310cc D70W, 245cc 20% Lipids**

**9mEq/bag Ca Gluconate & 25mM/bag Potassium Phosphate**

**Total Volume=1535cc**

**Ca** $\frac{9mEq}{1535cc} \times \frac{X}{1000cc}$ **P** $\frac{25mM}{1535cc} \times \frac{X}{1000cc}$

**X=5.9mEq/l** **X=16.3mM x 2 =32.6mEq/l**

**Total=5.9mEq + 32.6mEq = 38.5mEq**

**DO NOT EXCEED 40mEq**

**Standard PN Label Template**
**Adult Patient**

**Institution/Pharmacy Name, Address and Pharmacy Phone Number**

Name Dosing Weight Location
Administration Date/Time Expiration Date/time

| Base Formula | Amount/day | (Amount/L) |
|---|---|---|
| **Dextrose** | g | (g/L) |
| **Amino acids*** | g | (g/L) |
| **Lipid*** | g | (g/L) |
| Electrolytes | | |
| **Sodium chloride** | mEq | (mEq/L) |
| **Sodium acetate** | mEq | (mEq/L) |
| **Potassium chloride** | mEq | (mEq/L) |
| **Potassium acetate** | mEq | (mEq/L) |
| **Potassium phosphate** | mmol of P (mEq of K) | (mmol/L) (mEq/L) |
| **Sodium phosphate** | mmol of P (mEq of Na) | (mmol/L) (mEq/L) |
| **Calcium gluconate** | mEq | (mEq/L) |
| **Magnesium sulfate** | mEq | (mEq/L) |
| Vitamins, trace elements and medications | | |
| **Multiple vitamins*** | mL | |
| **Multiple trace elements*** | mL | |
| **Insulin** | Units | (Units/L) |
| **$H_2$ - antagonists*** | mg | |

Rate____mL/hr Volume_____mL Infuse over 24 hours

Admixture contains_____mL plus _____mL overfill

***Central Line Use Only***

## Guidelines for Daily Adult Electrolyte Requirements

| Electrolyte | SDR |
|---|---|
| Sodium | 1-2 mEq/kg |
| Potassium | 1-2 mEq/kg |
| Calcium | 10-15 mEq |
| Magnesium | 8-20mEq |
| Phosphorus (phosphate) | 20-40 mmol |
| Acetate/Chloride | as needed |

## Electrolytes

- Sodium
  - Chloride (1:1)
  - Acetate (1:1)
  - Lactate (avoid)
  - Bicarbonate (avoid)
- Potassium
  - Chloride (1:1)
  - Acetate (1:1)
- Phosphate
  - Potassium (3:4.4)
  - Sodium (3:4)
- Magnesium
  - sulfate
  - chloride
- Calcium
  - gluconate
  - chloride (avoid)
  - gluceptate (avoid)

## Electrolytes
## Acetate vs. Chloride

- Depends on acid-base status
- Generally, approximate equal amounts of chloride and acetate (1:1 ratio)
- Metabolic acidosis - maximum acetate, minimum chloride
- Metabolic alkalosis - maximum chloride, minimum acetate

## Metabolic Acidosis

- Anion Gap = $Na^+ - (Cl^- + HCO_3^-)$
  - 3-11 mEq/L or 12 ± 4 mEq/L
- Normal Anion Gap (Hyperchloremic Acidosis)
- Elevated Anion Gap

## Normal Anion Gap

- Hypokalemic
  - Diarrhea
  - Fistulous Disease
  - RTA-Type 1 (Distal)
  - RTA-Type 2 (Proximal)
  - Carbonic Anhydrase Inhibitors
- Hyperkalemic
  - Hypoaldosteronism
  - HCl
  - RTA-Type 4
  - $K^+$ Sparing Diuretics

## Elevated Anion Gap

- Severe Renal Failure
- Lactic Acidosis
- Ketoacidosis
  - Starvation, Ethanol, DM
- Drug Intoxications
  - Ethylene Glycol, Methanol, Salicylates

## Metabolic Alkalosis

- Saline Responsive
  - Urine Chloride < 10mEq/L
  - Diuretics
  - Gastric Loss (vomiting, NG suction)
  - Exogenous alkali administration
  - Alkalosis associated with hypokalemia

## Metabolic Alkalosis

- Saline-Resistant
  - Urine Chloride > 10mEq/L
  - Normotensive ($K^+$ depletion, hypercalcemia)
  - Hypertensive (Mineralcorticoids)

## Hypokalemia

- Intracellular Shift
  - Alkalosis
  - $B_2$ Adrenergic agonist
  - Insulin
- Decreased Intake
  - Alcoholism
  - Potassium-free IV
  - Anorexia nervosa/Bulimia

## Hypokalemia

- Hypomagnesemia
- Increased Output-Extrarenal
  - Vomiting
  - Diarrhea
  - Laxative abuse
  - Fisutla

## Hypokalemia

- Increased Output-Renal
  - Corticosteroids
  - Amphotericin B
  - Diuretics (Loop, Thiazides)
  - Hyperaldosteronism
  - Cushing's syndrome

## Hypokalemia - Treatment

| IV Dosing of Potassium Chloride | |
|---|---|
| Serum K+ (mEq/L) | Dose (mEq) |
| 3.5 – 3.9 | 40 mEq x 1 |
| 3.0 – 3.4 | 40 mEq x 2 |
| 2.0 – 2.9 | 40 mEq x 3 |

- Doses are based on average sized adults
- Do not use these doses for patients in renal impairment
- Check for hypomagnesemia
- Rate should NOT exceed 20 mEq/hour via CVC
- Peripheral IV: 10 mEq/100 mL; rate NOT > 10 mEq/hour

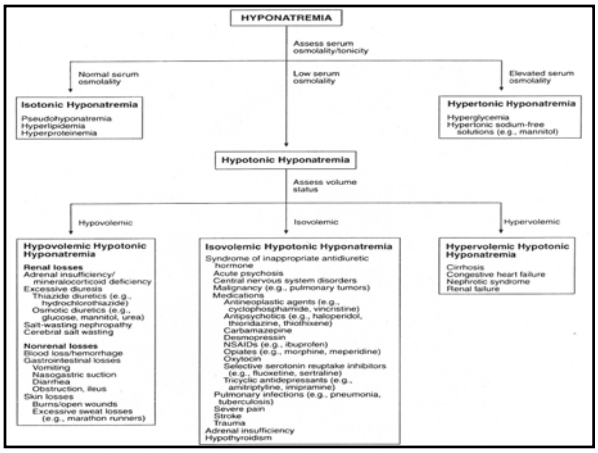
Dickerson RN. Hospital Pharmacy 2001; 36: 1201-1208

## Hyperkalemia

- Hemolysis
- Metabolic Acidosis
- Rhabdomyolysis
- Burns
- Salt substitutes
- Chronic or acute renal failure
- Adrenal insufficiency

## Hyperkalemia

- Drugs
  - Potassium Sparing Diuretics
  - ACEI/ARBS
  - NSAIDS
  - $B_2$ adrenergic antagonists
  - Heparin
  - Trimethoprim



## Fractional Excretion of Sodium ($FE_{Na}$)

$FE_{Na}$ (%) = $\frac{\text{Urine Na/Serum Na}}{\text{UCr/SCr}}$ x 100%

Values greater than 2% indicate kidneys are excreting a higher than normal fraction of filtered sodium.

Values less than 1% indicate renal sodium retention.

## $Fe_{Na}$ Results

- Low (<1%)
  - Prerenal azotemia
  - Acute glomerulonephritis
  - Hepatorenal Syndrome
  - Renal transplant rejection
- High (>1%)
  - ATN
  - Urinary obstruction
  - Chronic uremia
  - Diuretics

## Fractional Excretion of Sodium ($FE_{Na}$)

$FE_{Na}$ (%) = $\frac{\text{Urine Na/Serum Na}}{\text{UCr/SCr}}$ x 100%

Serum Na 120mEq/L  Urine Na 12mEq/L

Serum Cr 1.0 mg/dl  Urine Cr 32mg/dl

$FE_{Na}$ (%) = $\frac{\text{12mEq/L/120mEq/L}}{\text{32mg/dl/1mg/dl}}$ X 100%

= 0.3% trying to preserve sodium in the presence of hyponatremia. Implies a deficit in TBW with a larger deficit in TB sodium.

## Hypernatremia

- Serum sodium concentration > 145 mEq/L
- Again requires an assessment of extracellular volume status
  - Hypovolemic
  - Euvolemic
  - Hypervolemic

## Hypovolemic Hypernatremia

- Caused by loss of both water and sodium, however, water losses are greater
- Patients will have signs and symptoms of dehydration
  - Decreased blood pressure, UOP
  - Tachycardia
  - Depressed hemodynamic measurements
  - Dry mouth

## Hypovolemic Hypernatremia Treatment

- Initially, patients need salt and water replacement to perfuse vital organs (NS is usually initial treatment of choice)
- Once volume status has been corrected, hypotonic solutions are appropriate (D5W, ½ NS, ¼ NS)
- Dilute PN or EN formulations are appropriate (i.e. not concentrated formulations)

## Euvolemic Hypernatremia

- Caused by loss of primarily free water (thermal injury, fever, diabetes insipidus)
- Hypotonic fluids are the treatment of choice
  - IV – D5W, ½ NS, ¼ NS
  - PO/ Tube – water
- Delete sodium in PN temporarily
- Add water boluses to EN

## Hypervolemic Hypernatremia

- Caused by an excess of both water and sodium; however, sodium excesses are greater
- This is usually iatrogenic
- Minimize fluid/ eliminate sodium/ diuretics
- Concentrate PN formulation – eliminate Na
- Concentrate EN formulation (e.g. 2 kcal/ mL formula)

## Hypernatremia Calculations

- Free Water deficit equation
- Water deficit (L) =

  Dosing Factor x wt (kg) X ((serum Na/140) –1)
  Dosing Factor = 0.6 male or 0.5 female
  65 yo male 65 kg serum Na=160mEq/L

  0.6 x 65kg x((160/140)-1) = 5.6 L

## Drugs that can cause Nephrogenic Diabetes Insipidus

- Amphotericin B
- Cisplatin
- Colchicine
- Demeclocycline
- Gentamicin
- Lithium
- Loop Diuretics

## Drugs that can cause Nephrogenic Diabetes Insipidus

- Norepinephrine
- Osmotic Diuretics
- Thiazide Diuretics
- Vinblastine

## Hypophosphatemia

- Renal Loss
- Intracellular Shift
- Alcoholism
- Malnutrition
- TPN
- DKA Tx

## Hypophosphatemia

- Insulin
- Dextrose
- Phosphate Binders
- Aluminum/Calcium containing antacids
- Magnesium hydroxide
- Calcitonin
- B-adrenergic stimulants
- Diuretics

## Hypophosphatemia - Treatment

| IV Dosing of Phosphorus | |
|---|---|
| Serum Phosphorus (mg/dL) | Dose (mmol/kg) |
| 2.3 – 3.0 | 0.16 |
| 1.6 – 2.2 | 0.32 |
| < 1.6 | 0.64 |

- Do not use these doses for patients in renal impairment
- Increase phosphorus in parenteral nutrition if possible
- Use potassium salt if potassium < 4.0 mEq/L
- Use sodium salt if potassium > 4.0 mEq/L

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## Hyperphosphatemia

- Decreased renal phosphate excretion
- Shift to extracellular
- Increased intake of phosphate products
- Reduced PTH secretions
- Malignant conditions
  - Leukemias
  - Lymphomas

## Hyperphosphatemia

- Hidden Sources
  - Propofol
  - Clindamycin IV
  - TPN lytes
  - A.A./Glycerol Product

## Hypomagnesemia

- GI Tract
- ETOH abuse
- Transfusions
- Loop Diuretics
- Thiazide Diuretics
- Aminoglycosides
- Amphotericin B
- Cisplatin
- Cyclosporine
- Digoxin

## Hypomagnesemia - Treatment

| IV Dosing of Magnesium Sulfate | |
|---|---|
| Serum $Mg^{2+}$ (mg/dL) | Dose (mEq/kg) |
| 1.6 – 1.8 | 0.5 |
| 1.0 – 1.5 | 1 |
| < 1.0 | 1.5 |

- Do not use these doses for patients in renal impairment
- Increase $Mg^{2+}$ amount in IV/TPN if possible
- Rate should NOT exceed 8 mEq/hour
- Reassess after redistribution to tissues: 36 – 48 hours
- 8.12 mEq of magnesium sulfate ↑ serum ~ 0.1 mg/dL

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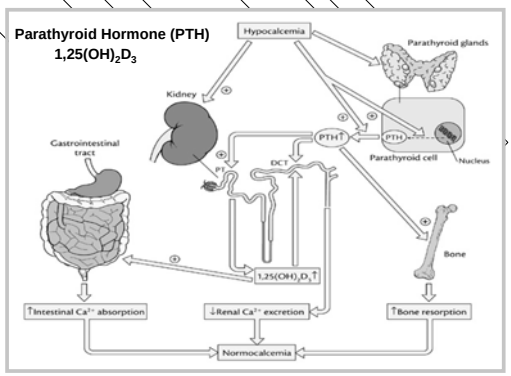
## Hypermagnesemia

- Renal dysfunction
- Magnesium containing antacids and laxatives
- Remove source, IV calcium used only in severe symptomatic patients to reverse CV and NM effects

## Calcium

- Normal adult contains ~ 1-2 g of calcium
- <1% of total calcium is located in the ECF
  - 43% protein-bound
  - 47% ionized
  - 10% complexed
- Functions
  - Muscle contraction
  - Bone metabolism
  - Coagulation & platelet adhesion
  - Neurotransmission

## Calcium Homeostasis



## Hypocalcemia

- Total serum calcium concentration < 8.5 mg/dL or an ionized calcium < 1.13 mmol/L
- Ionized calcium is physiologically active
  - Serum pH
  - Phosphorus
  - Albumin

Corrected serum $Ca^{2+}$ conc. = serum $Ca^{2+}$ conc. + 0.8 (4 – albumin)

## Causes of Hypocalcemia

- Lack of parathyroid hormone
  - After thyroidectomy, pseudohypoparathyroidism
  - Hypomagnesemia (blocks PTH secretion)
- Lack of vitamin D
  - Dietary deficiency, inadequate sunlight
  - Rickets, anticonvulsant therapy
  - Liver or renal disease
- Increased calcium complexation
  - Tumor lysis syndrome
  - Acute pancreatitis

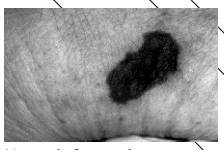
## Clinical Presentation Hypocalcemia

- Confusion
- Paresthesias
- Intestinal cramping & diarrhea
- Muscle spasms
- Cardiac arrhythmias
- Tetany

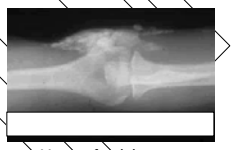
## Issues with Calcium Correction

- Risk of ectopic calcifications if Ca x P exceeds 55 $mg^2/dL^2$
- Calcium and phosphate compatibility
  - Gluconate salt preferred in TPN admixtures
  - Beware of phosphorus-containing amino acids
    - Freamine® III
    - HepatAmine®, 8% Hepatasol™

## Hazards with Calcium Infusions



Necrosis from subcutaneous Injection of calcium



X-ray of calcium gluconate extravasation

## Hazards with Calcium Infusions

Accidental subcutaneous infusion of calcium

Chronic eschar several days after accidental infusion

## Hypocalcemia - Treatment

| IV Dosing of Calcium Gluconate | |
|---|---|
| Ionized Calcium (mmol/L) | Dose (gram) |
| 1.0 – 1.12 | 1 |
| 0.9 – 0.99 | 2 |
| 0.8 – 0.89 | 3 |

- 1 gram calcium gluconate = 10 mL of 10% solution
- IV infiltration may cause severe tissue necrosis
- Exercise caution if patients are receiving digitalis alkaloids
- Increase calcium in parenteral nutrition if possible

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## Hypercalcemia

- Serum total calcium concentration > 10.5 mg/dL or an ionized calcium > 1.32 mmol/L
- Common causes
  - Primary hyperparathyroidism
  - Malignancies
- Clinical presentation
  - Nausea, vomiting, constipation
  - Polyuria, dehydration
  - Mental status changes, cardiac arrhythmias

## Hypercalcemia - Treatment

- Mild hypercalcemia does not require aggressive treatment
- Treat severe hypercalcemia ($Ca^{2+}$ > 13 mg/dL)
  - Hydration with normal saline
  - Loop diuretics
  - Bisphosphonates
- Decrease or remove calcium in parenteral nutrition

## Aluminum Toxicity

- More problematic in infants and small children; renal insufficiency
- Aluminum contamination of parenteral products (25mcg/L)
- Signs and symptoms
  - microcytic anemia
  - bone disease
  - dementia
  - impaired neurologic development

## Aluminum Toxicity

- Monitor aluminum concentrations (?)
- Minimize aluminum intake in patients at risk
- Consider all parenteral products, not just TPN
  - calcium
  - phosphate

## Clinical Conditions Warranting Cautious Use of PN

| | |
|---|---|
| Hyperglycemia | Glucose > 200mg/dl |
| Azotemia | BUN >80mg/dl |
| Hypernatremia | Na >150mEq/L |
| Hyponatremia | Na < 130mEq/L |
| Hypokalemia | K < 3mEq/L |
| Hypomagnesemia | Mg <1.2mEq/L |
| Hypocalcemia | Ionized Ca <0.8 mmol/L |
| Hyperchloremia M Acidosis | Cl >115mEq/L and $HCO_3$ < 15mEq/L |
| Hypophosphatemia | Phos < 2mg/dl |
| Hypochloremic M Alkalosis | Cl <85mEq/L and $HCO_3$ > 35mEq/L |

A.S.P.E.N. Parenteral Nutrition Handbook 2009

## Patients as Risk For Refeeding

- Anorexia Nervosa
- Chronic Malnutrition
- Severe obesity with massive weight loss
- Acutely ill patients NPO > 7 days
- Prolonged fasting
- Prolonged IV hydration without nutrition

## Case Study 1

P.T. 65 yo male admitted to SICU s/p MVC. Currently on mechanical ventilation, sedation with midazolam infusion. Patient's abdomen is distended with no bowel sounds c/w ileus. Nasogastric tube to suction with 300-400cc out per 8 hour shift.

Current Medication Regimen:

| | |
|---|---|
| Piperacillin/Tazobactam | 3.375 IV q 8h |
| Esomeprazole | 40mg IV daily |
| TPN 15% A.A. | 60cc/h |
| LR | 30cc/h (KVO) |
| Furosemide/Albumin/Chlorothiazide | 10cc/h |
| 240mg 5% 240mg | |

## Case Study 1

| Electrolytes: | | ABG | | |
|---|---|---|---|---|
| Sodium | 148 (135-145mEq/l) | pH | 7.52 | (7.35-7.45) |
| Potassium | 3.1 (3.5-5mEq/l) | $pCO_2$ | 48 | (35-45mmHg) |
| Chloride | 94 (98-107mEq/L) | PO2 | 70(80-100mmHg) | |
| $CO_2$ | **40** (22-31mEq/L) | $HCO_3$ | 39 | |
| BUN | 45 (7-20mg/dl) | Base Excess | 14.1 | ($\pm$ 2) |
| Cr | 2.5 (0.7-1.5mg/dl) | | | |

# Case Study 2

A.A. 44-year-old with past medical history significant for lupus is admitted via the ED. The patient has a two-day history of acute severe diarrhea. Patient is dx with RTA-Type 1 by nephrology. Day 8 of hospital stay, patient develops respiratory failure is intubated and transferred to ICU. Pt is placed on MV and sedated with lorazepam.

Current Medication Regimen:

| | |
|---|---|
| ½ NS | 50cc/h |
| TPN | 75cc/h |
| Lorazepam | 2mg/h |
| Enoxaparin 30mg SubQ | Daily |
| Esomeprazole 40mh IV | Daily |
| Levofloxacin 250mg | Daily |

# Case Study 2

| Electrolytes: | | | ABG | | |
|---|---|---|---|---|---|
| Sodium | 134 | (135-145mEq/l) | pH | 7.31 | (7.35-7.45) |
| Potassium | 2.9 | (3.5-5mEq/l) | pCO2 | 33 | (35-45mmHg) |
| Chloride | 108 | (98-107mEq/L) | PO2 | 93 | (80-100mmHg) |
| $CO_2$ | 16 | (22-31mEq/L) | $HCO_3$ | 16 | |
| BUN | 62 | (7-20mg/dl) | BD | -9 | (± 2) |
| Cr | 4.5 | (0.7-1.5mg/dl) | | | |