# Fluid and electrolyte management

Dr. Rezzan Khan
Consultant Nutritionist
Shifa International Hospital

**Table 8–2. Types of Fluid Imbalances**

| | Hypovolemia | Hypervolemia | Hypoproteinemia |
|---|---|---|---|
| Definition | Extracellular fluid deficit | Extracellular fluid excess | Loss of oncotic pressure leads to hypovolemia |
| Causes | Hemorrhage<br>Overdiuresis<br>Vomiting/diarrhea<br>Third-spacing (ascites, burns) | Congestive heart failure<br>Renal failure<br>Liver disease<br>Overzealous IV fluids<br>Sodium overload | Decreased protein intake<br>Increased protein loss<br>Liver/kidney disease<br>Burns<br>Infection<br>Hemorrhage |
| Clinical findings | Dry mucous membranes<br>Sudden weight loss<br>Oliguria<br>Tachycardia<br>Orthostatic hypotension | Sudden weight gain<br>Pitting edema<br>Tachycardia<br>Tachypnea<br>Elevated blood pressure<br>Elevated jugular venous pressure | Weight loss<br>Impaired healing<br>Edema<br>Immune compromise |
| Interventions | Correct underlying conditions<br>IV volume replacement<br>Isotonic fluid (0.9% NS, Lactated Ringers)<br>Whole blood, PC, plasma | Correct underlying conditions<br>Semi-Fowler's position<br>Administer diuretics<br>Limit sodium<br>Assess for signs and symptoms of pulmonary edema: crackles in lungs, cough, increased respiratory effort | Complete nutritional assessment<br>High-protein diet<br>IV replacement<br>Whole blood<br>Albumin<br>Plasma |

# Learning Objectives

- Concept of Fluid & Electrolyte Balance
- Body fluid and electrolyte homeostasis
- Differentiate between hypovolemic, euvolemic, and hypervolemic hyponatremia
- Recommend appropriate changes in nutrition support formulations for treatment of electrolyte abnormalities

# Functions of Body Fluid

- **Fluid balance** ensures that the body stays hydrated;
- **important** for normal functioning of the body and optimal health.
- Maintaining **fluid balance** is vital for physical and mental performance.
- Water is one of the most essential nutrients that the body requires.

# Why Fluid balance is important

- Loss of 10% body fluid = 8% weight loss **SERIOUS**
- Loss of 20% body fluid = 15% weight loss **FATAL**
- Fluid gained each day should = fluid lost each day
  (2 -3L/day average)
- What is the minimum output per hour necessary to maintain renal function? 30 ml/hr

# More to consider?

- Age
  - Infants
  - Older adults
- Prior medical history
  - Acute illness
  - Chronic illness
  - Environmental factors
  - Diet
  - Lifestyle
  - Medications

# Total Body Water

- Fetus: 90% water
- Premie: 80% water
- Term: 70-75% water
- Young children: 65-70%
- Adolescents: 60% water

Lean individuals: greater percentage of body weight is water

Fat individuals: smaller percentage of body weight is water

# Predictive Equations for Estimating Adult Fluid Requirements

| Method | Equation |
|---|---|
| Body Surface Area (BSA) Method | 1,500 mL/m2 x BSA = mL/day |
| Recommended Dietary Allowance/Adolph Method | 1 mL/kcal of intake = mL/day |
| Fluid Balance Method | Urine output + 500 mL/day |
| Weight Method | 25–35 mL/kg/day |
| Age-adjusted Weight Method | Average healthy adult: 30–35 mL/kg/day<br>Adult 55–65 years old: 30 mL/kg/day<br>Adult > 65 years old: 25 mL/kg/day |
| Obese Adult Patient Method | [(kg body weight–20) x 15] + 1,500 mL/day |

# Baseline Fluid Requirement

- **Afebrile 70-kg Adult*:*** 35 mL/kg/24 h
- **If not a 70-kg Adult*:*** Calculate the water requirement according to K**g Method?**
- For the first 10 kg of body weight: 100 mL/kg/d plus
- For the second 10 kg of body weight: 50 mL/kg/d plus
- For the weight above 20 kg: 20 mL/kg/d

# Homeostasis

- State of equilibrium in body
- Naturally maintained by adaptive responses
- Body fluids and electrolytes are maintained within narrow limits

# Triggers and actions of antidiuretic hormone (ADH


*Effective circulating volume

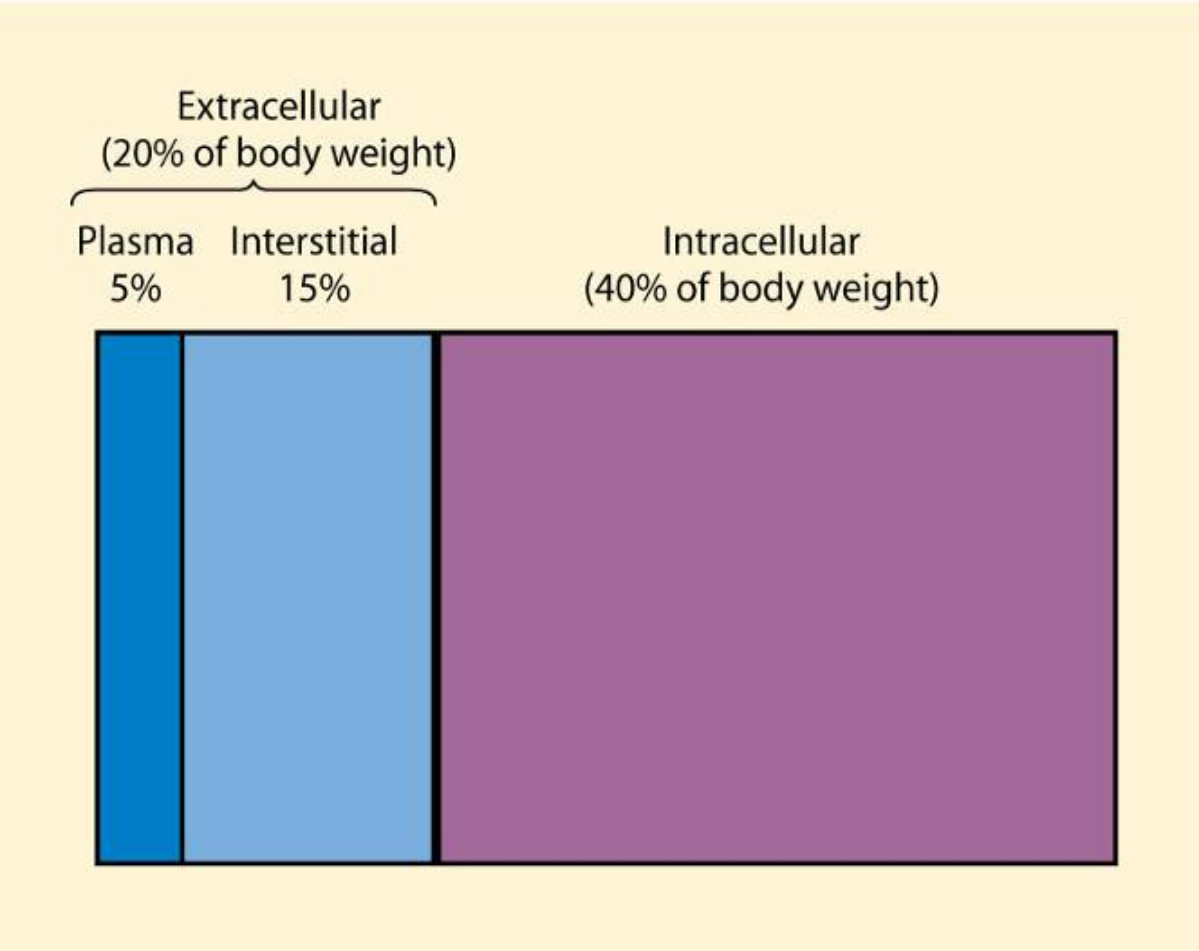
# Action of the renin-angiotensin-aldosterone system (RAAs)


*Effective circulating volume

# Actions of atrial natriuretic peptide (ANP)


*Effective circulating volume

# Fluid Compartments of the Body



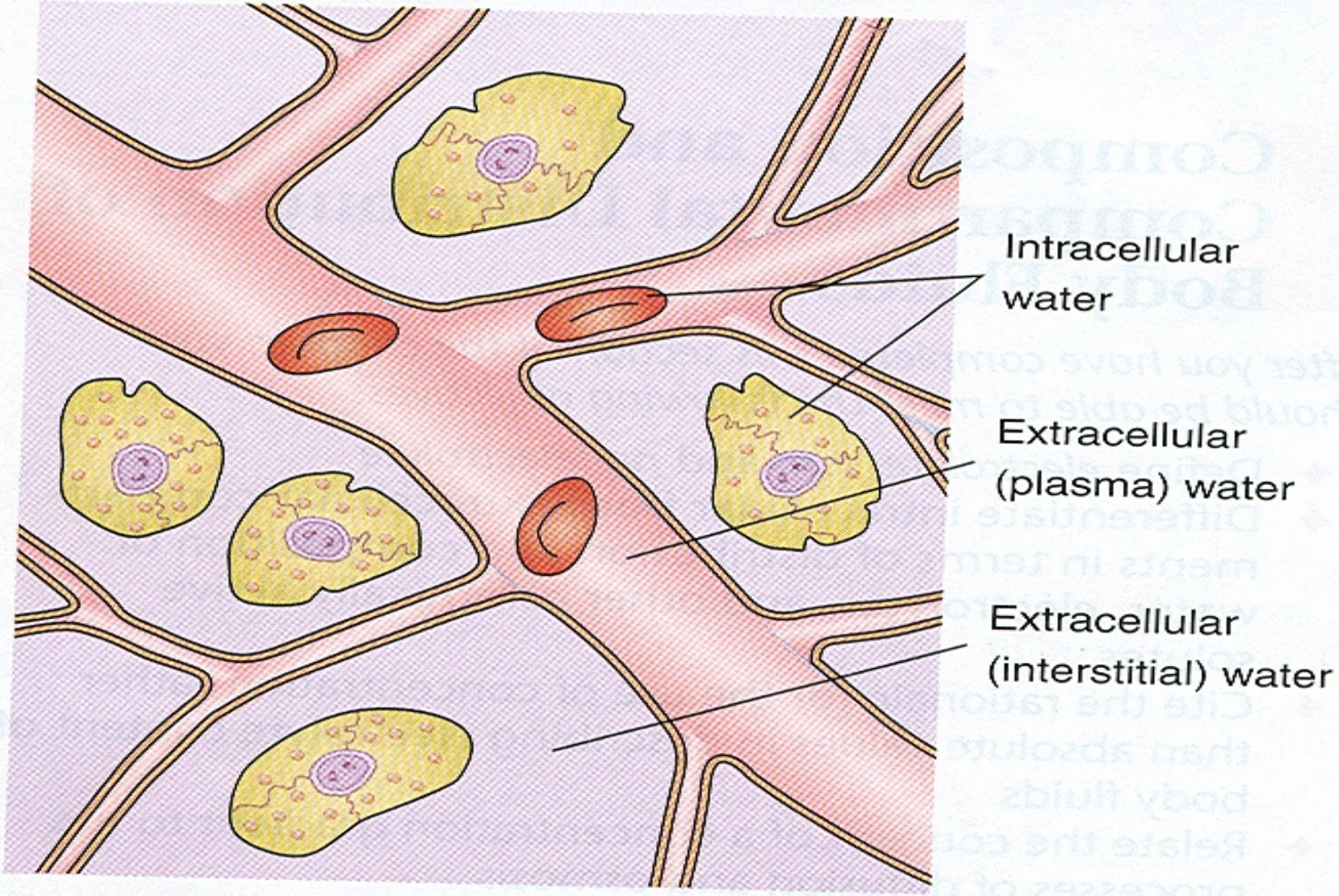



**FIGURE 31-1** Distribution of body water. The extracellular space includes the vascular compartment and the interstitial spaces.

The intravascular volume of an average 70 kg man is approximately 5 L of which 2 L is red cell volume and 3 L plasma volume. The intravascular, extracellular fluid compartment equilibrates with the extracellular, extravascular fluid compartment (ECF ~ 11 L), with a reduction in one compartment leading to a reduction of the other.

Plasma to interstitial fluid shift results in *edema*

Water deficit (increased ECF) Associated with symptoms that result from cell shrinkage as water is pulled into vascular system

Water excess (decreased ECF) Develops from gain or retention of excess water

Plasma to interstitial fluid shift results in *edema*

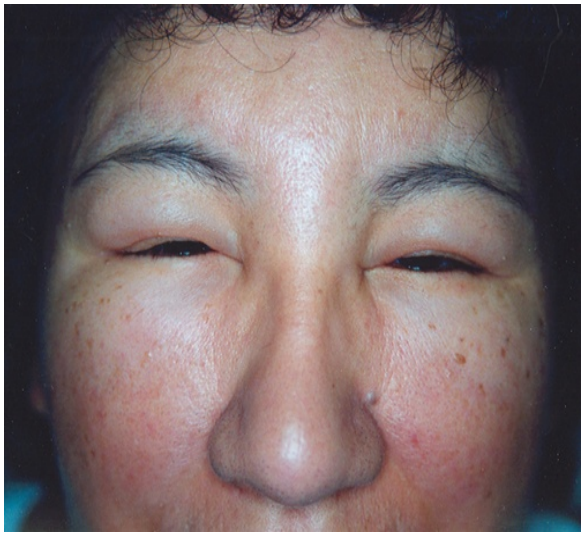
Water deficit (increased ECF) Associated with symptoms that result from cell shrinkage as water is pulled into vascular system

Water excess (decreased ECF) Develops from gain or retention of excess water

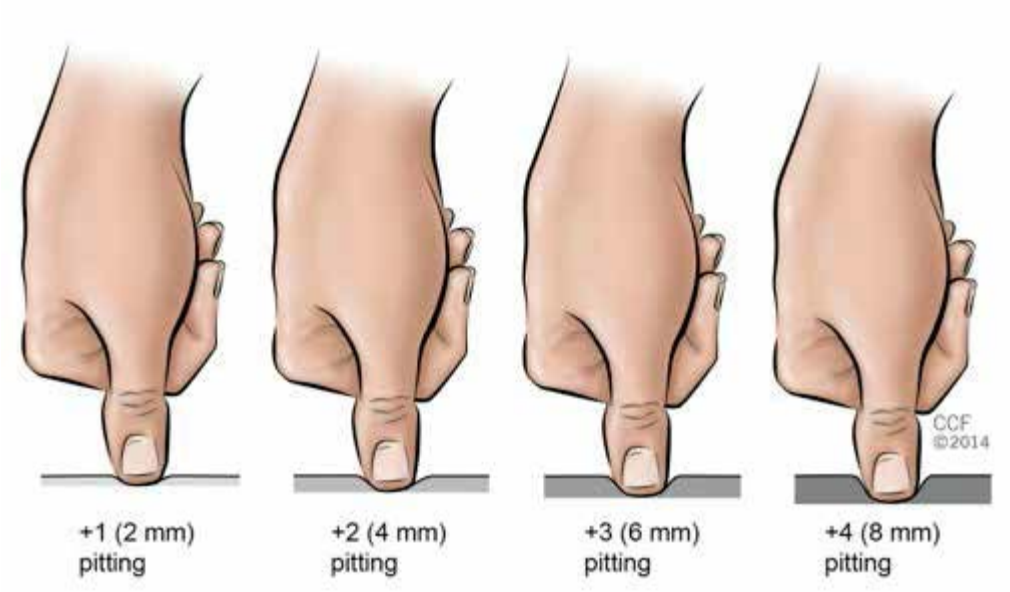
# Fluid Spacing

- First spacing
  - Normal distribution of fluid in ICF and ECF
- Second spacing
- Abnormal accumulation of interstitial fluid (edema)
- Third spacing
  - Fluid accumulation in part of body where it is not easily exchanged with ECF; fluid trapped and unavailable for functional use (ascites)

3rd spacing, fluid shift from intravascular to interstitial space; edema



# Severity grading of pitting edema using pit depth.



- Treating an ECF requires aggressive management of sepsis, fluid, and renal function; nutritional, electrolyte, and metabolic support; management of fistula output; assessment of fistula anatomy; and when appropriate, corrective surgery.

# types of fluid imbalances

| | Hypovolemia | Hypervolemia | Hypoproteinemia |
|---|---|---|---|
| Definition | Extracellular fluid deficit | Extracellular fluid excess | Loss of oncotic pressure leads to hypovolemia |
| Causes | Hemorrhage<br>Overdiuresis<br>Vomiting/diarrhea<br>Third-spacing (ascites, burns) | Congestive heart failure<br>Renal failure<br>Liver disease<br>Overzealous IV fluids<br>Sodium overload | Decreased protein intake<br>Increased protein loss<br>Liver/kidney disease<br>Burns<br>Infection<br>Hemorrhage |
| Clinical findings | Dry mucous membranes<br>Sudden weight loss<br>Oliguria<br>Tachycardia<br>Orthostatic hypotension | | |

# Types and causes of dehydration

| Type | Description and Causes |
| --- | --- |
| Isotonic | Equal loss of sodium and water<br>Gastrointestinal illness |
| Hypertonic | Most common cause<br>Water loss exceeds sodium loss<br>Fever<br>Limited fluid intake |
| Hypotonic | Sodium loss exceeds water loss<br>Diuretic use |

# Fluid Volume Deficit (Hypovolemia, Isotonic Dehydration)

- **Common Causes**
  - Hemorrhage
  - Vomiting
  - Diarrhea
  - Burns
  - Diuretic therapy
  - Fever
  - Impaired thirst

# Clinical Manifestations

- **Signs/Symptoms**
  - Weight loss
  - Thirst
  - Orthostatic changes in pulse rate and bp
  - Weak, rapid pulse
  - Decreased urine output
  - Dry mucous membranes
  - Poor skin turgor

# interventions can prevent dehydration

- Encourage patient fluid intake of 1,000–3,000 ml daily (e.g., filling a pitcher each day and making sure it is empty at the end of the day)
- Monitor patient lab values for changes.
- -- Increased BUN/creatinine
- -- Increased serum sodium
- -- Increased serum osmolarity
- -- Increased hematocrit.
- • Monitor patient urine output.
- • Monitor patient for constipation or diarrhea.
- • Weigh patient daily.
- • Teach patient to drink despite not feeling thirsty, particularly if taking diuretics.
- • Advise patient to avoid alcoholic, carbonated, and caffeinated beverages, which can increase diuresis.

# Treatment/Interventions (FVD)

- **Fluid Management**
  - Diet therapy – Mild to moderate dehydration. Correct with oral fluid replacement.
  - Oral rehydration therapy – Solutions containing glucose and electrolytes.  E.g., Pedialyte, Rehydralyte.
  - IV therapy – Type of fluid ordered depends on the type of dehydration and the clients cardiovascular status.

**Table.** Characteristics of Three Types of Hyponatremia

| | Hypovolemic Hyponatremia | Euvolemic Hyponatremia | Hypervolemic Hyponatremia |
|---|---|---|---|
| Laboratory Values | • Serum osmolarity low (<280 mOsm/L)<br>• Urine osmolality >450 mOsm/kg | • Serum osmolarity low (<280 mOsm/L)<br>• Urine osmolality >100 mOsm/kg with urine Na >20 mEq/L OR <100 mOsm/kg with urine Na >20 mEq/L | • Serum osmolarity low (<280 mOsm/L)<br>• Urine osmolality >100 mOsm/kg |
| ECF Volume Symptoms | • Tachycardia, hypotension, decreased skin turgor | • No edema; normal pulse, blood pressure, skin turgor | • Edema |
| Associated Medical Conditions | • Urine Na >20 mEq/L: renal losses, Addison disease, cerebral salt wasting, osmotic diuresis<br>• Urine Na <20 mEq/L: vomiting, diarrhea, high-output ostomies, enterocutaneous fistulas, burns, pancreatitis | • Urine Na >20 mEq/L: hypothyroidism, SIADH, stress, secondary adrenal insufficiency<br>• Urine Na <20 mEq/L: primary polydipsia, low solute intake (beer potomania, "tea and toast" diet) | • Urine Na >20 mEq/L: acute or chronic renal failure<br>• Urine Na <20 mEq/L: CHF, cirrhosis, nephrotic syndrome |
| ECF Volume Status | • Total body water ↓<br>• Total body sodium ↓ | • Total body water ↑<br>• Normal total body Na | • Total body water ↑<br>• Total body Na ↑ |
| Treatment | • Infusion of hypertonic or isotonic saline; discontinue diuretics | • Fluid restriction | • Dialysis for renal failure; fluid and sodium restriction |

CHF=congestive heart failure, ECF=extracellular fluid, Na=sodium, SIADH=syndrome of inappropriate antidiuretic hormone secretion

Data from Whitmire SJ. Nutrition-focused evaluation and management of dysnatremias. *Nutr Clin Pract.* 2008;23(2):108–121.

# Fluid Volume Excess

- **Common Causes:**
  - Congestive Heart Failure
  - Early renal failure
  - IV therapy
  - Excessive sodium ingestion
  - SIADH
  - Corticosteroid

# Clinical Manifestations

- **Signs/Symptoms**
  - Increased BP
  - Bounding pulse
  - Venous distention
  - Pulmonary edema
    - Dyspnea
    - Orthopnea (diff. breathing when supine)
    - crackles

# Treatment/Interventions (FVE)

- Drug therapy
  - Diuretics may be ordered if renal failure is not the cause.
- Restriction of sodium and saline intake
- I/O
- Weight

# Specific Replacement Fluids replace excessive, nonphysiologic losses.

- ***Gastric Loss (Nasogastric Tube, Emesis):*** D5 1/2 NS with 20 mEq/L (mmol/L)potassium chloride (KCl)
- ***Diarrhea:*** D5LR with 15 mEq/L (mmol/L) KCl. Use body weight as a replacement guide (about 1 L for each 1 kg, or 2.2 lb, lost)

# Isotonic Crystalloid

- **Normal Saline (0.9%)**

(Na 154 meq/L, Cl 154 meq/L)

- **Lactate Ringer's (Hartman's solution)**

(Na 130 meq/L, Cl 109 meq/L, K 4 meq/L, Lactate 28 meq/L, Ca 3 meq/L)

- Normosol-R (Na 140 meq/L, Cl 90 meq/L, K 5 meq/L, Mg 3 meq/L)
- Plasmalyte (Na 140 meq/L, Cl 98 meq/L, K 5 meq/L, Mg 3 meq/L)

# Isotonic Crystalloid

| Fluid | Glucose (g/L) | Electrolytes (mEq/L) | | | | | | | kcal/L |
|---|---|---|---|---|---|---|---|---|---|
| | | $Na^+$ | $Cl^-$ | $K^+$ | $Ca^{2+}$ | $HCO_3^{-}$* | $Mg^{2+}$ | $HPO_4^{-2}$ | |
| $D_5W$ (5% dextrose in water) | 50 | – | – | – | – | – | – | – | 170 |
| $D_{10}W$ (10% dextrose in water) | 100 | – | – | – | – | – | – | – | 340 |
| $D_{20}W$ (20% dextrose in water) | 200 | – | – | – | – | – | – | – | 680 |
| $D_{50}W$ (50% dextrose in water) | 500 | – | – | – | – | – | – | – | 1700 |
| ½ NS (0.45% NaCl) | – | 77 | 77 | – | – | – | – | – | – |
| 3% NS | – | 513 | 513 | – | – | – | – | – | – |
| NS (0.9% NaCl) | – | 154 | 154 | – | – | – | – | – | – |
| $D_5$¼NS | 50 | 38 | 38 | – | – | – | – | – | 170 |
| $D_5$¼NS (0.45% NaCl) | 50 | 77 | 77 | – | – | – | – | – | 170 |
| $D_5$½NS (0.9% NaCl) | 50 | 154 | 154 | – | – | – | – | – | 170 |
| $D_5$LR (5% dextrose in lactated Ringer's) | 50 | 130 | 110 | 4 | 3 | 27 | – | – | 180 |
| Lactated Ringer's | – | 130 | 110 | 4 | 3 | 27 | – | – | <10 |
| Ionosol MB | 50 | 25 | 22 | 20 | – | 23 | 3 | 3 | 170 |
| Normosol M | 50 | 40 | 40 | 13 | – | 16 | 3 | – | 170 |

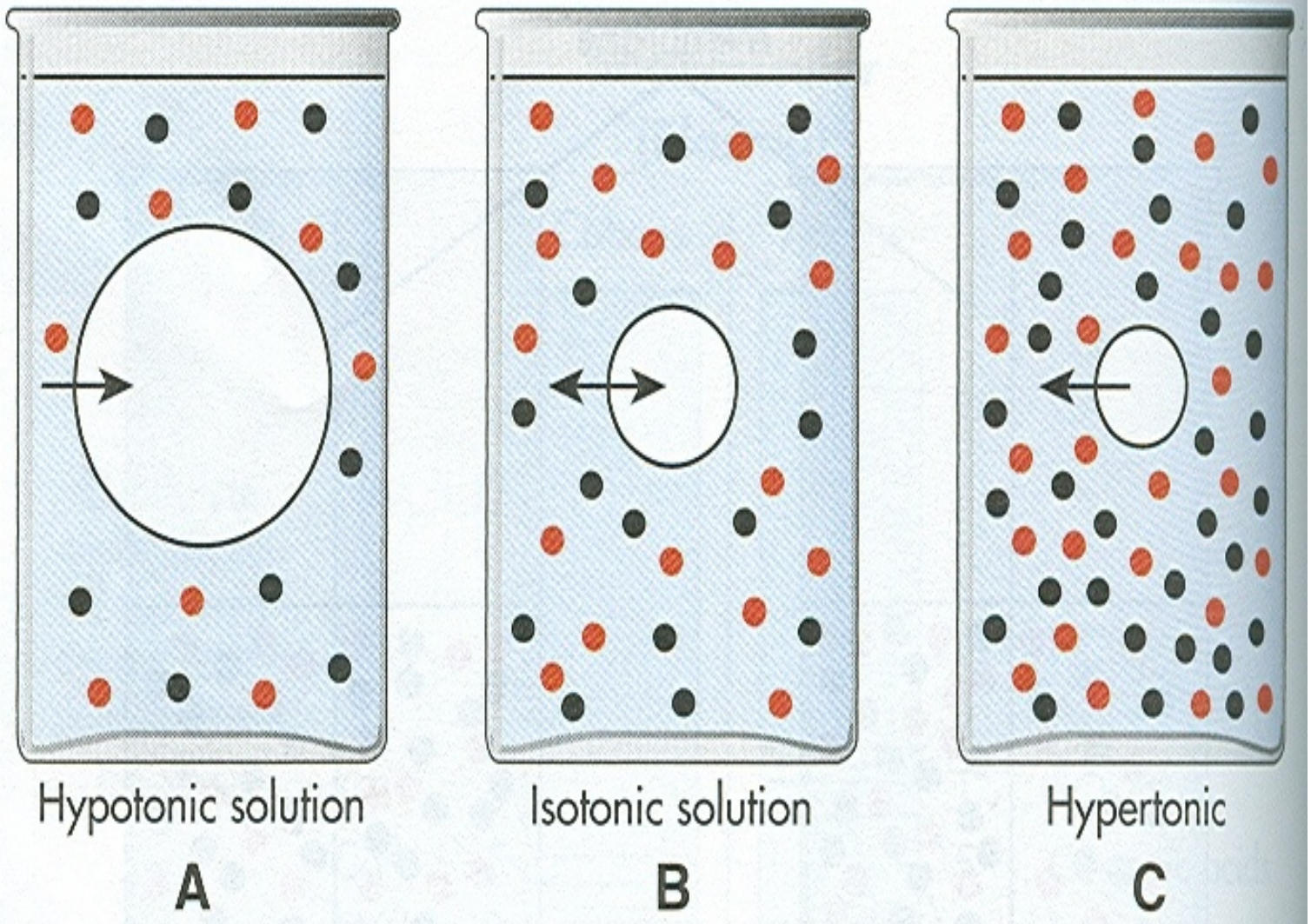
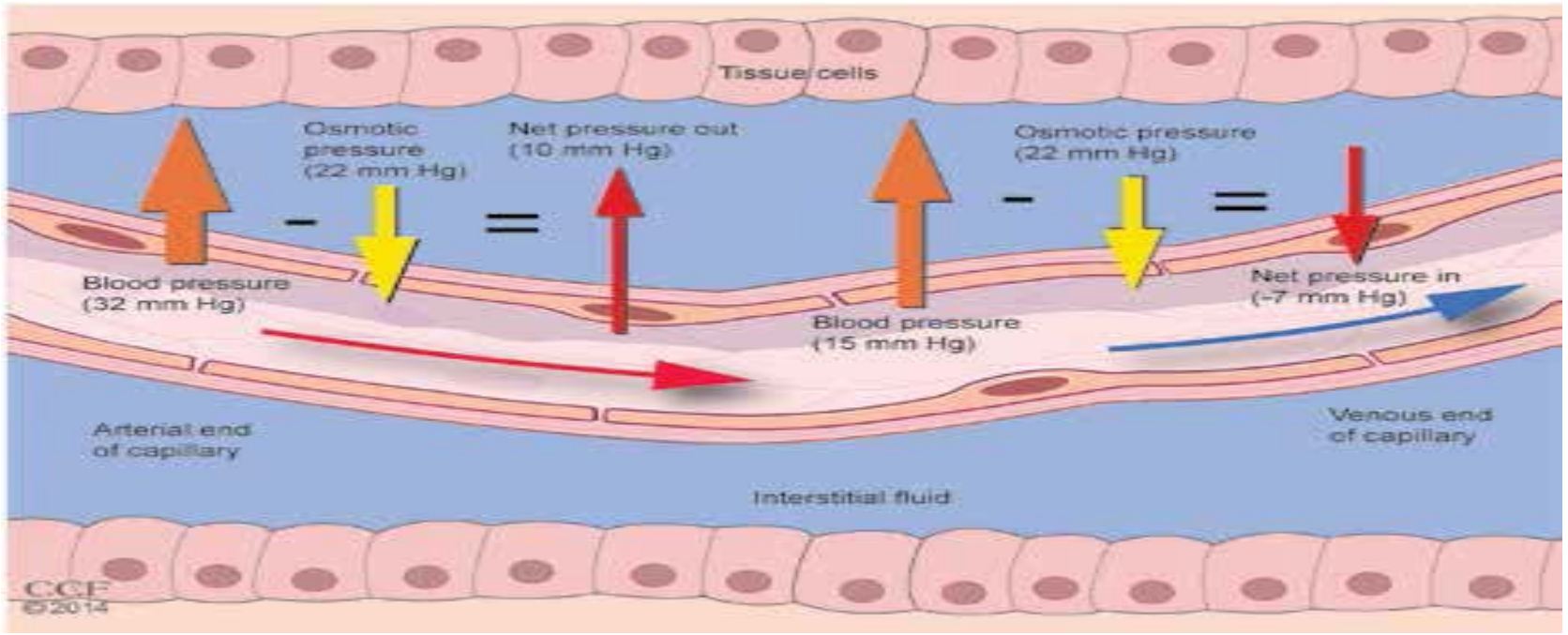



FIG. 17-7 Effects of water status on cell size. **A,** Hypotonic solution ($H_2O$ excess) results in cellular swelling. **B,** Isotonic solution (normal $H_2O$ balance) results in no change. **C,** Hypertonic solution ($H_2O$ deficit) results in cellular shrinking.

# Intravascular and interstitial pressure effect on fluid movement



# Four Steps for Diagnosis and Treatment of Hyponatremia

- The goal is to find and correct the underlying cause.
- 1. Determine presence and severity of signs and symptoms.
- 2. Determine speed of onset: acute onset necessitates rapid correction of sodium; chronic onset necessitates slow correction of sodium.
- 3. Determine osmolality (tonicity): rule out isotonic and hypertonic osmolality.
- 4. Establish extracellular fluid volume status.

# Hyponatremia Symptoms Associated With Serum Sodium Concentrations

| Serum Sodium Concentrations | Symptoms |
|---|---|
| 125 to 130 mEq/L | No symptoms, nausea, malaise, vomiting ,disorientation |
| 115 to 125 mEq/L | Headache, lethargy ,obtunded, agitation, confusion, altered mental status |
| <115 mEq/L | Seizures, coma, respiratory distress, death |

Symptoms vary widely and are patient-specific.

"Sodium and Fluids Disorders", Clinical Nutrition Week 2012,

# Calculations to Estimate Sodium Deficit and Treatment for Case Study

Initial Data:

- 49-year-old female
- Weight: 50 kg
- Plasma sodium day 1: 123 mEq/L
- Plasma sodium day 2: 126 mEq/L
- Day 1 IV fluids: 1 L normal saline (sodium content is 154 mEq/L) (3)
- Day 2 IV fluids: 1.5 L normal saline

Step 1: Calculate total body water

Total Body Water (TBW) for men: 0.6 L/kg x weight in kg

Total Body Water (TBW) for women: 0.5 L/kg x weight in kg (3) Calculation for DD: 0.5 x 50 = 25 L

Step 2: Calculate sodium deficit

Sodium deficit : TBW x ([desired plasma sodium – current plasma sodium])*(3)

Calculation for DD: 25 x (133 – 123) = 25 x 10 = 250 mEq

Step 3: Calculate how much 1 L normal saline** initially increases plasma sodium (7): Increase in plasma sodium = (sodium in NS – plasma sodium) ÷ (TBW + 1) Calculation for DD: (154 – 123) ÷ (25 +1) = 31 ÷ 26 = 1.19mEq/L

# Hypervolemia

- **Hypervolemia**, or fluid overload, is the medical condition where there is too much fluid in the blood.
- The opposite condition is hypovolemia, which is too little fluid volume in the blood.
- occurs when the body retains more water than it needs.

# What causes hypervolemia?

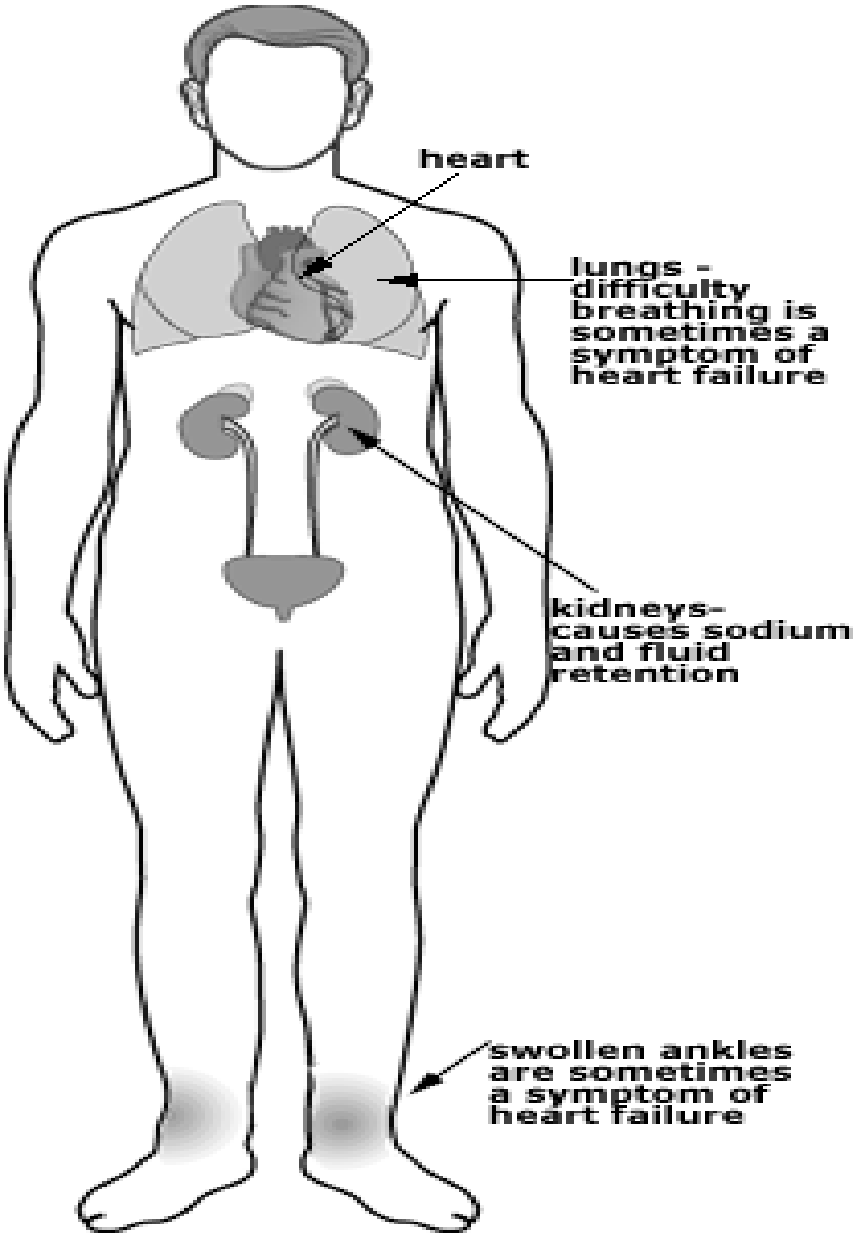
- disruption in the salt/water balance in the body
- short term illness, injury or surgery
  - **Intravenous Fluids**
  - **Injury/Illness/Surgery**
- can also be due to long-term health conditions.
- **Kidney Disease**
- **Liver Disease**
- **Heart Disease**

# What are the symptoms of hypervolemia?

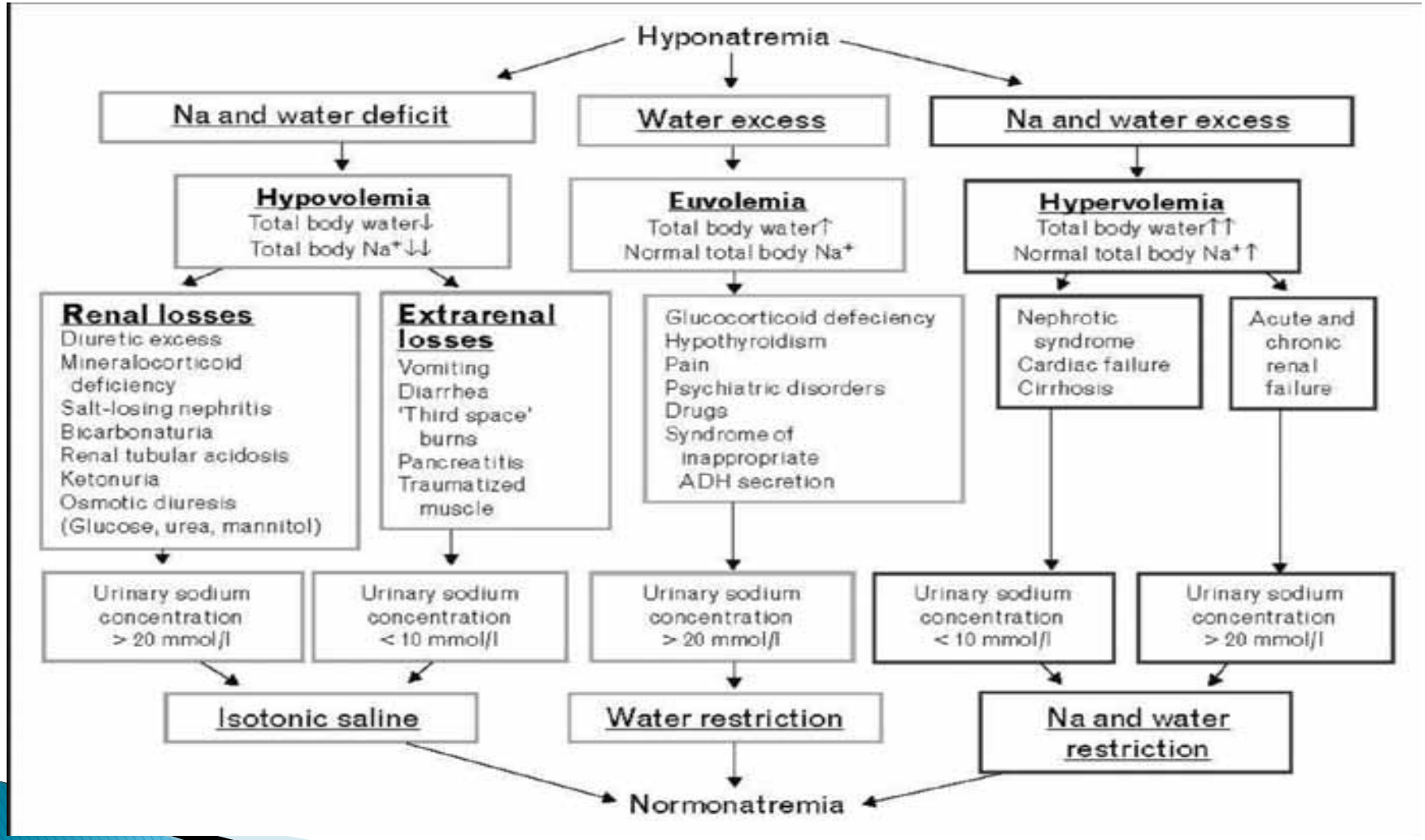
The symptoms of hypervolemia are consistent with excess water in the body

- Moist Cough
- Frothy Sputum
- Increased or Slowed Heart Rate
- Changes in Blood Pressure
- Swollen abdomen
- Shortness of Breath

symptoms of hypervolemia



# Algorithm to classify and treat hypotonic hyponatremia with different extracellular fluid volumes based on a primary clinical assessment of the patient.



# Electrolyte Imbalance

# Consideration when assessing electrolyte imbalance

- **Considerations When**
- **Assessing Electrolyte Imbalances**
- • Electrolyte content of nutrition
- products (i.e., parenteral nutrition,
- enteral nutrition)
- • Addition or removal of medications
- (i.e., spironolactone, furosemide,
- insulin)
- • IV fluids and piggybacks (i.e., normal
- saline with potassium)
- • Underlying disease states (i.e., acute
- renal injury, acid-base disorders)

# Hypokalemia (<3.5mEq/L)

- Pathophysiology –
  - Decrease in K+ causes decreased excitability of cells, therefore cells are less responsive to normal stimuli

# Hypokalemia (<3.5mEq/L)

- Contributing factors:
  - Diuretics
  - Shift into cells
  - Digitalis
  - Water intoxication
  - Corticosteroids
  - Diarrhea
  - Vomiting

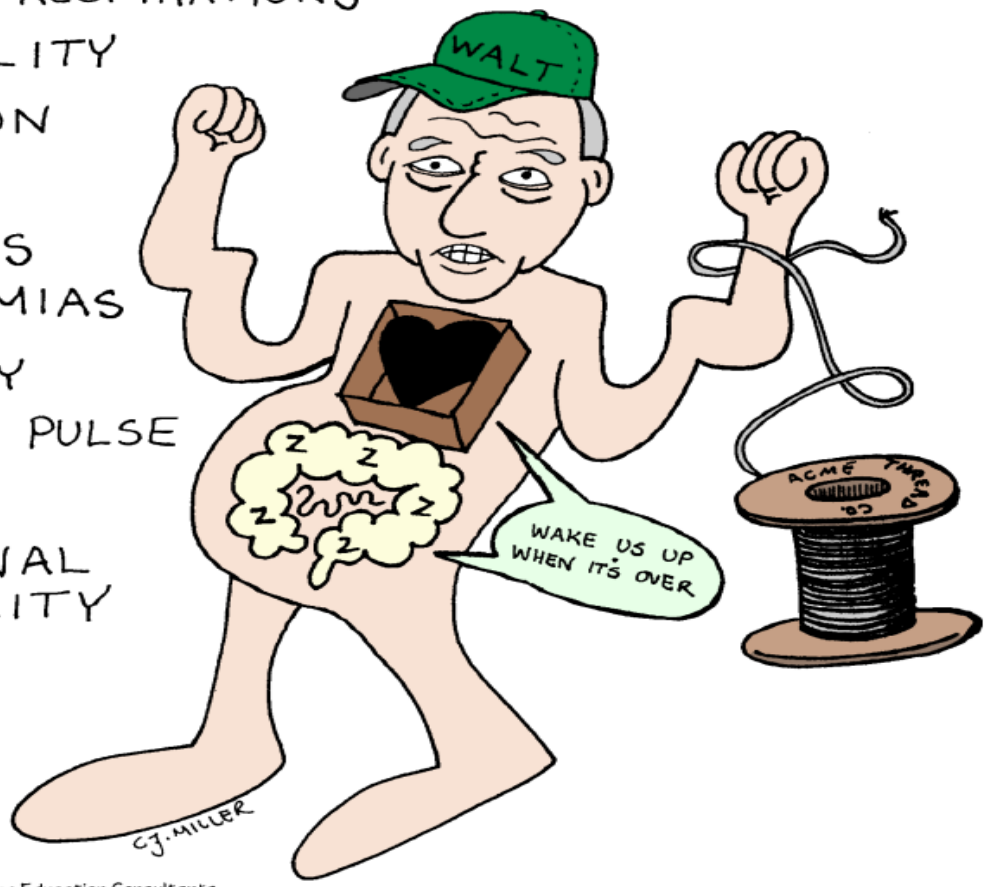
# POTASSIUM $K^+$ DEFICIT

* ALKALOSIS

* SHALLOW RESPIRATIONS
* IRRITABILITY
* CONFUSION

* WEAKNESS
* ARRHYTHMIAS
* LETHARGY
* THREADY PULSE

* ↓ INTESTINAL MOTILITY



# Hypokalemia (<3.5mEq/L)

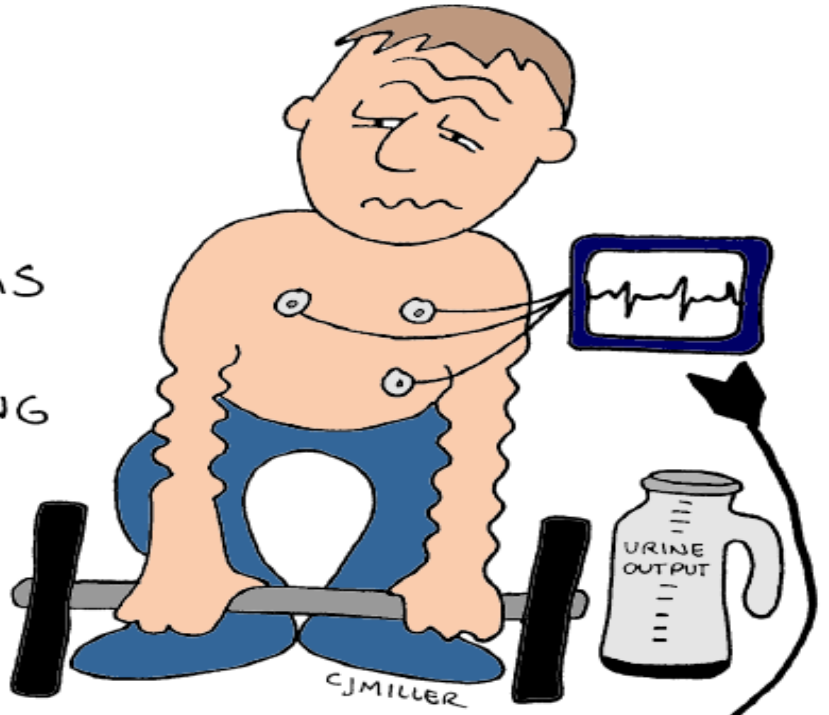
- Interventions
  - Assess and identify those at risk
  - Encourage potassium-rich foods
  - K+ replacement (IV or PO)
  - Monitor lab values
  - D/c potassium-wasting diuretics
  - Treat underlying cause

# Hyperkalemia (>5.0mEq/L)

- Pathophysiology – An inc. in K+ causes increased excitability of cells.

# HYPERKALEMIA $K^+$ ↑

* MUSCLE CRAMPS → WEAKNESS → PARALYSIS
* DROWSINESS
* ↓ BP
* EKG CHANGES
* DYSRHYTHMIAS
* ABDOMINAL CRAMPING
* DIARRHEA
* OLIGURIA






# Hyponatremia (<135mEq/L)

- Interventions/Treatment
  - Restore Na levels to normal and prevent further decreases in Na.
  - Drug Therapy –
    - (FVD) – IV therapy to restore both fluid and Na. If severe may see 2-3% saline.
    - (FVE) – Administer osmotic diuretic (Mannitol) to excrete the water rather than the sodium.
  - Increase oral sodium intake and restrict oral fluid intake.

# Hypernatremia (>145mEq/L)

- **Contributing Factors**
  - Hyperaldosteronism
  - Renal failure
  - Corticosteroids
  - Increase in oral Na intake
  - Na containing IV fluids
  - Decreased urine output with increased urine concentration

# Hypernatremia (>145mEq/L)

- **Contributing factors (cont'd):**
  - Diarrhea
  - Dehydration
  - Fever
  - Hyperventilation

# Hypernatremia (>145mEq/L)

- **Assessment findings:**
  - Neuro – Spontaneous muscle twitches. Irregular contractions. Skeletal muscle wkness. Diminished deep tendon reflexes
  - Resp. – Pulmonary edema
  - CV – Diminished CO. HR and BP depend on vascular volume.

# Hypernatremia (>145mEq/L)

GU – Dec. urine output.  Inc. specific gravity

Skin – Dry, flaky skin.  Edema r/t fluid volume changes.

# Hypernatremia (>145mEq/L)

- **Interventions/Treatment**
  - **Drug therapy**
    - (FVD) .45% NSS. If caused by both Na and fluid loss, will administer NaCL. If inadequate renal excretion of sodium, will administer diuretics.
  - Diet therapy
    - Mild – Ensure water intake

# Hypocalcemia (<9.0mg/dL)

- **Contributing factors**:
  - Dec. oral intake
  - Lactose intolerance
  - Dec. Vitamin D intake
  - End stage renal disease
  - Diarrhea

# Hypocalcemia (<9.0mg/dL)

- **Assessment findings:**
  - Neuro –Irritable muscle twitches.
  - Resp. – Resp. failure , muscle tetany.
  - CV – Decreased HR., decreased BP, diminished peripheral pulses
  - GI – Increased motility. Increased BS. Diarrhea

# Hypercalcemia (>10.5mg/dL)

- **Contributing factors:**
  - Excessive calcium intake
  - Excessive vitamin D intake
  - Renal failure
  - Hyperparathyroidism
  - Malignancy
  - Hyperthyroidism

# Hypercalcemia (>10.5mg/dL)

- Assessment findings:
  - Neuro – Disorientation, lethargy, coma, profound muscle weakness
  - Resp. – Ineffective resp. movement
  - **CV** – Increased HR, Increased BP. , Bounding peripheral pulses, Positive Homan's sign.
    Late Phase – Bradycardia, Cardiac arrest
  - **GI** – Dec. motility. Dec. BS. Constipation
  - **GU** – Inc. urine output. Formation of renal calculi

# Hypercalcemia (>10.5mg/dL)

- **Interventions/Treatment**
  - Eliminate calcium administration
  - Drug Therapy
  - Isotonic NaCL (Inc. the excretion of Ca)
  - Diuretics
  - Calcium reabsorption inhibitors (Phosphorus)
  - Cardiac Monitoring

*Oral* – Low-calcium diet

*IV – Increased infusion of NS*

# Hypophosphatemia (<2.5mg/L)

- **Contributing Factors:**
  - Malnutrition
  - Starvation
  - Hypercalcemia
  - Renal failure
  - Uncontrolled DM

# Hypophosphatemia (<2.5mg/L)

- **Assessment findings**
  Neuro – Irritability, confusion
  CV – Decreased contractility
  Resp. – Shallow respirations
  Musculoskeletal – destruction of muscle cells
  Hematologic – Increased bleeding
  Decreased platelet aggregation

# Hypophosphatemia (<2.5mg/L)

- **Interventions**
  - Treat underlying cause
  - Oral replacement with vit. D
  - IV phosphorus (Severe)
  - Diet therapy
    - Foods high in oral phosphate

# Hyperphosphatemia (>4.5mg/L)

- Causes few direct problems with body function.  Care is directed to hypocalcemia.
- Rarely occurs

# Hypomagnesemia (<1.4mEq/L)

- **Contributing factors:**
  - Malnutrition
  - Starvation
  - Diuretics
  - Aminoglcoside antibiotics
  - Hyperglycemia
  - Insulin administration

# Hypomagnesemia (<1.4mEq/L)

- **Assessment findings**:
  *Neuro – Hyperreflexia. Seizures
  *CV – ECG changes. Dysrhythmias. HTN
  *Resp. – Shallow resp.
  *GI – Decreased motility. Anorexia. Nausea

# Hypomagnesemia (<1.4mEq/L)

- **Interventions:**
  - Eliminate contributing drugs
  - IV MgSO4
  - Assess DTR's hourly with MgSO4
  - Diet Therapy

# Hypomagnesemia (<1.4mEq/L)

- **Contributing factors:**
  - Malnutrition
  - Starvation
  - Diuretics
  - Aminoglcoside antibiotics
  - Hyperglycemia
  - Insulin administration

# Hypomagnesemia (<1.4mEq/L)

- **Assessment findings:**
  *Neuro – Positive Trousseau's sign. Positive Chvostek's sign. Hyperreflexia. Seizures
  *CV – ECG changes. Dysrhythmias. HTN
  *Resp. – Shallow resp.
  *GI – Dec. motility. Anorexia. Nausea

# Equations Used to Assess Electrolyte Abnormalities

| Electrolyte | Normal Range | Equations |
|---|---|---|
| Corrected magnesium (Mg2+) | 1.7 to 2.5 mg/dL | Serum Mg2+ x 0.005(40 – serum albumin mg/dL) |
| Corrected calcium | 8.0 to 11.0 mg/dL | ([4 – serum albumin (g/dL)] x 0.8) + measured calcium (mg/dL) |
| Total body water (TBW) | n/a | (men) = 0.6 L/kg x weight in kg(women) = 0.5 L/kg x weight in kg |
| Sodium deficit (mEq) | n/a | TBW x (140 – measured serum sodium concentration mEq/L) |
| Water deficit (in L) | n/a | TBW x ([serum sodium concentration mEq/L/140] – 1) |
| Serum osmolality (sOsm) | 280 to 300 mOsm/L | (2 x serum sodium in mEq/L) + (serum glucose in mg/dL/18) + (BUN in mg/dL/2.8) |
| HCO3– deficit (mmol) | n/a | 0.5 x ([HCO3–] normal – [HCO3–] measured |

# Commonly Observed Symptoms During Electrolyte Imbalance

| Electrolyte | Elevation | Depletion |
|---|---|---|
| Calcium | Present in concentrations >11 mg/dL; lethargy, anorexia, nausea, vomiting, polyuria, confusion, coma | Hyperactive reflexes, muscle cramps numbness with tingling of fingers, tetany, convulsion |
| Phosphorus | Anorexia, nausea, vomiting, hyperactive reflexes, tetany, tachycardia, muscle weakness | Confusion, seizures, coma, chest pain, difficulty speaking or breathing, weakness, joint stiffness |
| Magnesium | Nausea, vomiting, diaphoresis altered mental status, coma, muscle weakness | Weakness, lethargy, muscle cramps, mood changes, confusion, vomiting |
| Sodium | Increased thirst, fatigue, restlessness, muscle irritability, seizures, coma and death | Nausea, vomiting, headache, muscle cramps, disorientation, weakness, lethargy, confusion, dizziness, seizure, coma and death |
| Potassium | Muscle cramping, weakness, electrocardiographic changes, arrhythmia | Constipation, lethargy, weakness, leg cramps |

# Considerations for Treatment of Electrolyte Abnormalities

| Electrolyte | Elevation | Depletion |
|---|---|---|
| Calcium | *Oral* – Low-calcium diet<br>*IV – Increased infusion of NS* | *Oral*– 1,000 to 1,500 mg/day<br>*IV(tetany present)*<br>10 to 20 mL of 10% calcium gluconate over ≥4 hrs |
| Phosphorus | *Oral*–<br>.Low-phosphorus diet<br>. Phosphate binders<br>*IV*<br>• Assess the need for volume repletion | *Oral*–<br>• Increased dietary intake<br>• Oral supplementation (i.e., Na3PO4)<br>*IV*<br>Moderate) • 0.32 to 0.64 mmol/kg (maximum, 30 mmol)Na3PO4 slowly over 6 hrs<br>*IV (Severe) • 1 mmol/kg (maximum, 80 mmol) Na3PO4 slowly over* 8 to 12 hrs |
| Magnesium | *Oral* | *Oral* |
| | | |
| | | |

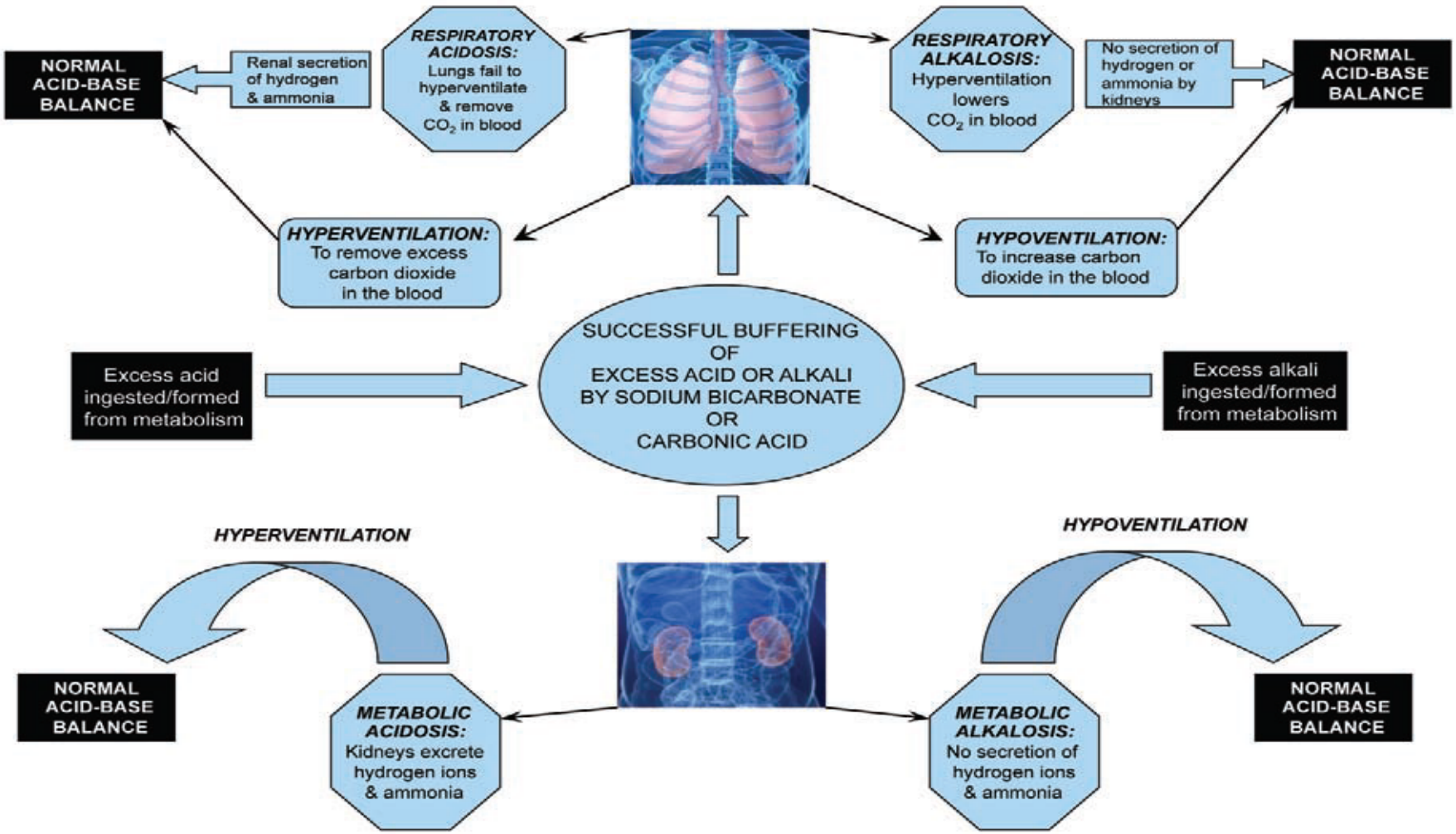
# World Health Organization ORS

| Substrate | mmol/L |
|---|---|
| Sodium | 90 |
| Potassium | 20 |
| Bicarbonate | 30 |
| Chloride | 80 |
| Glucose | 111 |

# ORS Recipe

- **Ingredients**
- 1 L (33 oz) water
- ¾ tsp table salt (sodium chloride)
- 1 tsp baking power (or 2 tsp baking soda)
- 4 tbsp sugar (sucrose)
- ½ tsp 20% potassium chloride*
- Sugar-free Kool-AidR or Crystal LightR to taste
- **Directions**
- Pour all ingredients into a blender or pitcher. Mix well.

# Achieving acid-base balance



# Expected Changes in Primary Acid-Base Disorders

| Acid-Base Disorder | pH | Primary Change | Compensating Reaction |
|---|---|---|---|
| Metabolic acidosis | ↓ | ↓HCO3 | ↓ PCO2 |
| Metabolic alkalosis | ↑ | ↑HCO3 | ↑ PCO2 |
| Respiratory acidosis | ↓ | ↑PCO2 | ↑ HCO3 |
| Respiratory alkalosis | ↑ | ↓PCO2 | ↓ HCO3 |

- Acidosis: process that lowers the extracellular fluid pH (reduction in $HCO_3$ or elevation in $pCO_2$)

- Alkalosis: process that raises extracellular pH (elevation in $HCO_3$ or fall in $pCO_2$)

# Six-step process for assessing blood gases.

- *Step 1: Analyze the pH*

Normal blood pH is 7.4±0.05, forming the range 7.35 to 7.45..

- *Step 2: Analyze the CO2*

Normal Pco2 values are 35 to 45 mm Hg. Below 35 mm Hg is alkalotic; above 45 mm Hg is acidic.

- *Step 3: Analyze the HCO3*

A normal HCO3 is 22 to 26 mEq/L. If the HCO3 is below 22 mEq/L, the patient is acidotic. If the HCO3 is above 26 mEq/L, the patient is alkalotic.

- *Step 4: Match the CO2 or the HCO3 with the pH*
- Matching either the Pco2 or the HCO3 with the pH can determine the acid-base disorder.
- For example, if the pH is acidotic and the CO2 is acidotic, the acid-base disturbance is
- being caused by the respiratory system and represents respiratory acidosis. If the pH is
- alkalotic and the HCO3 is alkalotic, the acid-base disturbance is being caused by the
- metabolic (or renal) system and represents metabolic alkalosis.
- *Step 5: Does the CO2 or HCO3 go in the opposite direction of the pH?*
- If the CO2 or HCO3 goes in the opposite direction of the pH, compensation is occurring. For
- example, when the pH is acidotic, the CO2 is acidotic, and the HCO3 is alkalotic, the CO2
- matches the pH,making the primary acid-base disorder respiratory acidosis. The HCO3
- being the opposite of the pH is evidence of compensation fromthemetabolic system.
- *Step 6: Analyze the Po2 and the O2 saturation*
- If the PaO2 and O2 saturation are below normal, there is evidence of hypoxemia.

# Conclusion

- Understanding the relationship between electrolytes and their movement within TBW during altered hydration status, electrolyte imbalances, or acid-base imbalance is key to developing a thorough nutrition plan care.
- With this knowledge , electrolyte abnormalities can be prevented or treated safely

- A **diet** rich in highly alkaline fruits and vegetables helps reduce a marker of **metabolic acidosis** and preserve kidney function in patients with chronic kidney disease. ... ACE inhibitors were given to patients to control blood pressure
- If your alkalosis is caused by a loss of chemicals such as chloride or potassium, you'll be prescribed medications or supplements to replace these chemicals.
- Some cases of alkalosis result from an electrolyte imbalance, which may be corrected by drinking plenty of fluids or drinks that contain electrolytes. If you have an advanced case of electrolyte imbalance, it will need to be treated in the hospital.