I. FLUIDS AND ELECTROLYTES

*** Please note all normal ranges for blood tests will depend on the lab performing the test. The normal values listed in this book are to be used as references only. ***

A. Fluid Volume Excess: Hypervolemia

- Define: too much fluid in the _____

1. Causes:

a. Heart Failure (HF): heart is _____, CO _____, decreased _____ perfusion, UO _____
*the volume stays in the _____

b. Renal Failure (RF): Kidneys aren't _____.

c. Alka-Seltzer
Fleet enema
IVF with Na
→ All 3 have a lot of _____.

2. Hormonal Regulation of Fluid Volume

a. Aldosterone (steroid, mineralocorticoid):

- Where is aldosterone found? _____
- Normal action: when blood volume gets low (vomiting, blood loss, etc.) →aldosterone secretion increases →**retain Na/water → blood volume goes** _____

  **Disease with too much aldosterone:
  _____
  _____

  **Disease with too little aldosterone:
  _____

b. Atrial Natriuretic Peptide (ANP)

- Where is ANP found? _____ of the heart
- How does it work? The _____ of aldosterone.
- So it causes _____of Na and H_2O.

c. ADH (Anti-diuretic Hormone):

- Normally makes you retain or diurese? _____
- Retain? _____

Two ADH Problems	
Too Much ADH	**Not Enough ADH**
Retain _____	Lose (diurese) _____
Fluid Volume _____	Fluid Volume _____
SIADH	DI _____
Syndrome of Inappropriate ADH Secretion	Diabetes Insipidus
(TOO MANY _____ TOO MUCH_____)	Urine _____
Urine _____	Blood _____
Blood _____	

*Concentrated makes the #'s go up

*Dilute makes #'s go down

Urine specific gravity, sodium, and hematocrit

- ADH is found in the _____;
- Key words to make you think potential ADH problem: craniotomy, head injury, sinus surgery, transphenoidal hypophysectomy or any condition that could lead to increased ICP there is a risk of an ADH problem.
- Trans-_____, sphenoid _____, hypophysis_____, ectomy_____

*Another name for anti-diuretic hormone (ADH) is Vasopressin (Pitressin®). The drug Vasopressin (Pitressin®) or Desmopressin Acetate (DDAVP®) may be utilized as an ADH replacement in diabetes insipidus.

3. S/S:

a. Distended neck vein/peripheral veins: vessels are _____

b. Peripheral edema, third spacing: vessels can't hold anymore so they start to _____.

c. CVP: measured where _____; number goes____
More_____ More_____

CVP Normal:
2-6 mmHg
5-10 cmH_2O
Depending on measuring device used

d. Lungs sounds: _____

e. Polyuria: kidneys trying to help you _____

f. Pulse: _____; your heart only wants fluid to go_____

g. If the fluid doesn't go forward it's going to go _____ into the lungs.

h. BP: _____ more volume….more_____

i. Weight:_____ any acute gain or loss isn't fat-it's fluid

4. Tx:

TESTING STRATEGY
Fluid Retention
Think Heart
Problems FIRST

a. Low Na diet/ restrict fluids

b. I & O and Daily _____

c. Diuretics:

- Loop: Example: _____

  Burmetanide (Bumex®) may be given when Furosemide (Lasix®) doesn't work.

- Hydrochlorothiazide (Thiazide®) Watch lab work with all diuretics.
  Dehydration and electrolyte problems
- K+ sparing: Example: _____

d. Bed rest induces _____ by release of _____ and, ↓ production of_____.

e. Physical assessment

f. Give IVF's slowly to elderly.

TESTING STRATEGY
Anytime you see assessment or evaluation on the NCLEX®, you should be looking for the presence or absence of the pertinent _____ and _____.

B. Fluid Volume Deficit: Hypovolemia

Big Time Deficit=Shock

1. Causes:

a. Loss of fluids from anywhere
Examples: Thoracentesis, paracentesis, vomiting, diarrhea, hemorrhage

b. Third spacing (Definition: When fluid is in a place that does you no good)
- Burns
- Ascites

c. Diseases with polyuria
Polyuria→ Oliguria→ Anuria

> **NCLEX® Critical Thinking Exercise:**
> What sequence would you use to assess the client with orthostatic hypotension?
> 1. Assess the vital signs with the client sitting.
> 2. Assess the vital signs with the client lying.
> 3. Assess the vital signs with the client standing.
> 4. Record BP and pulse with the position noted.
> 5. Have the client lie down for at least 3 min.

2. S/S:

a. Weight _____

b. Decreased skin turgor

c. Dry mucous membranes

d. Decreased urine output
- Kidneys either aren't being _____or they are trying to hold on to_____. (compensate)

e. BP? _____ (less _____, less _____)

f. Pulse? _____, heart is trying to pump what little is left around

g. Respirations? _____

h. CVP? _____ (less volume, less _____)

i. Peripheral veins/neck veins vasoconstrict (very tiny).

j. Cool extremities (peripheral _____ in an effort to shunt blood to _____organs)

k. Urine specific gravity _____if putting out any urine at all it will be _____

3. Tx:

a. Prevent further _____.

b. Replace volume
- Mild Deficit: _____
- Severe Deficit: _____

c. Safety Precaution
- Higher risk for _____
- Monitor for overload.

C. Quickie IV Fluid Lecture

1. **Isotonic Solutions:** Go into the vascular space and stays there!

   a. **Examples**: _____,_____,_____,D5¼ NS

   b. **Uses:** The client that has lost fluids through nausea, vomiting, burns, sweating, trauma.

      - Normal Saline is the basic solution when administering blood.

   c. **Alert:** Do not use isotonic solutions in clients with hypertension, cardiac disease or _____ disease.

      These solutions can cause FVE, or _____.

2. **Hypotonic Solutions:** Go into the vascular space then shift out into the cells to replace cellular fluid.

   They rehydrate but do not cause _____.

   a. **Examples:** _____, 0.33% NS, $D_{2.5}W$

   b. **Uses:** The client who has hypertension, renal or cardiac disease and needs fluid replacement because of nausea, vomiting, burns, hemorrhage, etc.

      - Also used for dilution when a client has hypernatremia, and for cellular dehydration.

   c. **Alert:** Watch for cellular edema because this fluid is moving out to the cell which could lead to fluid volume _____ and decrease blood pressure.

3. **Hypertonic Solutions:** Volume expanders that will draw fluid into the _____ _____ from the _____.

   a. Examples: D10W, 3% NS, 5% NS, D5LR, D5½ NS, D5 NS, TPN, Albumin

   b. Uses: The client with hyponatremia or has shifted large amounts of vascular volume to a 3rd space or has severe edema, burns, or ascites.

   - A hypertonic solution will return the fluid volume to the vascular space.

   c. Alert: Watch for fluid volume _____. Monitor in an ICU setting with frequent monitoring of blood pressure, pulse, and CVP.

Isotonic=Crystalloid
Hypertonic=Colloid

Quick Tips for IV Solutions

Isotonic Solutions

"Stay where **I** put it!"

Hyp**o**tonic Solutions

"Go **O**ut of the vessel"

Hyp**e**rtonic Solutions

"**E**nter the Vessel"

D. Magnesium And Calcium

Fact: Magnesium is excreted by **kidneys** and it can be lost other ways, too (GI tract)

Hypermagnesemia

1. **Causes:**
   - **a.** Renal _____
   - **b.** Antacids

Hint: Mg & Ca think muscles first

2. **S/S:**
   - **a.** Flushing
   - **b.** Warmth
   - **c.** Mg makes you _____

S/S
DTR's, _____
Muscle Tone_____
Arrhythmias_____
LOC_____
Pulse_____
Respirations_____

3. **Tx:**
   - **a.** Ventilator
   - **b.** Dialysis
   - **c.** Calcium gluconate

**Calcium gluconate is administered IVP very slowly (Max rate: 1.5-2 ml/min).

   - **d.** Safety precautions

Normal Lab Values
Mg: 1.2-2.1 mEq/L
Calcium: 9.0-10.5 mg/dl

Hypercalcemia

1. **Causes:**
   - **a.** Hyperparathyroidism: too much_____

     When your serum calcium gets low parathormone (PTH) kicks in and pulls Ca from the _____ and puts in the blood, therefore, the serum calcium goes ___.

   - **b.** Thiazides (retain _____)
   - **c.** Immobilization (you have to bear weight to keep Ca in the ____).

2. **S/S:**
   - **a.** Bones are brittles
   - **b.** Kidney stones

*majority made of calcium

3. **Tx:**
   - **a.** Move!
   - **b.** Fluids prevent _____
   - **c.** Phospho Soda® & Fleet ® Enema both have phosphorous
     Ca has inverse relationship with _____.
     When you drive Phos up, Ca goes _____
   - **d.** Steroids
   - **e.** Add what to diet? _____
   - **f.** Safety Precautions
   - **g.** Must have Vitamin ___to use Ca.
   - **h.** Calcitonin_____serum Ca.

Hypomagnesemia

1. **Causes:**
   - **a.** Diarrhea- lots of Mg in intestines
   - **b.** Alcoholism
   - **c.** Alcohol suppresses ADH & it's hypertonic
     - Not eating
     - Drinking

Hypocalcemia

1. **Causes:**
   - **a.** Hypoparathyroidism
   - **b.** Radical neck
   - **c.** Thyroidectomy

Not Enough _____

Normal Lab Values
Mg: 1.2-2.1 mEq/L
Calcium: 9.0-10.5 mg/dl

Hint: If you want to get Mg & Ca questions right, think muscles 1st.

2. S/S:
Muscle Tone _____
Could my client have a seizure? _____
Stridor/laryngospasm- airway is a smooth _____
+Chvostek's – tap cheek ("C" is for Cheek)
+Trousseau's – pump up BP cuff
Arrhythmias – heart is a _____
DTR's _____
Mind Changes
Swallowing Probs – esophagus is a smooth_____
these sign and symptoms are common in a client with hypomagnesium or hypocalcemia

3. **Tx:**
   - **a.** Give some Mg
   - **b.** Check _____ function (before and during IV Mg)

NCLEX® Critical Thinking Exercise:
A client receiving $MgSO_4$ IV has a drop in output:
- Call the doctor
- Decrease the infusion
- Stop the infusion
- Reassess in 15 min.

   - **c.** Seizure precautions
   - **d.** Eat Magnesium

3. **Tx:**
   - **a.** Vit D
   - **b.** Phosphate binders
     Sevelamer hydrochloride (Renagel®)
     Calcium Acetate (PhosLo®)
     Calcium Carbonate (Os-Cal®)
   - **c.** IV Ca (GIVE SLOWLY) and Always make sure client is on a _____.

NCLEX® Critical Thinking Exercise:
Intervention is required with which client?
Client with a history of grand-mal seizures or a client with 8 hrs post heart cath.

Foods high in magnesium: spinach, mustard greens, summer squash, broccoli, halibut, turnip greens, pumpkin seeds, peppermint, cucumber, green beans, celery, kale, sunflower seeds, sesame seeds, and flax seeds

   - **e.** What do you do if your client begins to c/o flushing and sweating when you start IV Mg? _____

E. Sodium

Normal Lab Values
Sodium: 135-145 mEq/L

Your Na level in your blood is totally dependent on how much **water** you have in your body.

Hypernatremia=Dehydration

Too much Na; not enough _____

1. **Causes:**
   - **a.** Hyperventilation
   - **b.** Heat stroke
   - **c.** DI
2. **S/S:**
   - **a.** Dry mouth
   - **b.** Thirsty-already dehydrated by the time you're thirsty
   - **c.** Swollen tongue
3. **Tx:**
   - **a.** Restrict _____.
   - **b.** Dilute client with fluids. Diluting makes Na go_____
   - **c.** Daily weights
   - **d.** I & O
   - **e.** Lab work

   } If you've got a Na problem you've got a _____ problem.

Hyponatremia=Dilution

Too much water; not enough _____

1. **Causes:**
   - **a.** Drinking H_2O for fluid replacement (vomiting, sweating)
     - This only replaces water and dilutes the blood.
   - **b.** Psychogenic polydipsia: loves to drink _____
   - **c.** D_5W (sugar & water)
   - **d.** SIADH Retaining _____
2. **S/S:**
   - **a.** Headache
   - **b.** Seizure
   - **c.** Coma
3. **Tx:**
   - **a.** Client needs _____.
   - **b.** Client doesn't need _____.
   - **c.** If having neuro probs: needs hypertonic saline
     - Means "packed with particles"
     - 3% NS or 5% NS

TESTING STRATEGY

Neuro changes: Brain doesn't like it when Na's messed up.

this sign and symptom is common in a client with hypernatremia or hyponatremia

Case in Point: Feeding tube clients- tend to get _____.

F. Potassium

Normal Lab Values
Potassium: 3.5-5.0 mEq/L

Excreted by **kidneys**

Kidneys not working well, the serum potassium will go _____.

Hyperkalemia

1. **Causes:**
   - **a.** Kidney trouble
   - **b.** Aldactone- makes you retain _____.
2. **S/S:**
   - **a.** Begins with muscle twitching
   - **b.** Then proceeds to weakness
   - **c.** Then flaccid paralysis
3. **Tx:**
   - **a.** Dialysis- Kidneys aren't working
   - **b.** Calcium gluconate decreases _____.
   - **c.** Glucose and insulin
     Insulin carries _____ & _____ into the cell.
     Any time you give IV insulin worry about _____ & _____.
   - **d.** Sodium Polystyrene Sulfonate (Kayexalate®)

Hypokalemia

1. **Causes:**
   - **a.** Vomiting
   - **b.** NG suction
     We have lots of K+ in our stomach
   - **c.** Diuretics
   - **d.** Not eating
2. **S/S:**
   - **a.** Muscle cramps
   - **b.** Weakness
3. **Tx:**
   - **a.** Give _____.
   - **b.** Aldactone makes them retain ___.
   - **c.** _____ more potassium.

← Life-Threatening Arrhythmias →

ECG changes with hyperkalemia: bradycardia, tall and peaked T waves, prolonged PR intervals, flat or absent P waves, and widened QRS, conduction blocks, ventricular fibrillation.
ECG changes with hypokalemia: U waves, PVCs, and ventricular trachycardia

Sodium and Potassium have an _____ relationship.

4. **Miscellaneous Information:**
   - **a.** Major problem with PO K+? _____
   - **b.** Assess UO before/during IV K+.
   - **c.** Always put IV K+ on a _____.
   - **d.** Mix well!
   - **e.** Never give IV K+ _____!
   - **f.** Burns during infusion? _____

Foods high in potassium: spinach, fennel, kale, mustard greens, Brussel sprouts, broccoli, eggplants, cantaloupe, tomatoes, parsley, cucumber, bell pepper, apricots, ginger root, strawberries, avocado, banana, tuna, halibut, cauliflower, kiwi, oranges, lima beans, potatoes (white or sweet), and cabbage.