Fluid Management and Dehydration

National Pediatric Nighttime Curriculum

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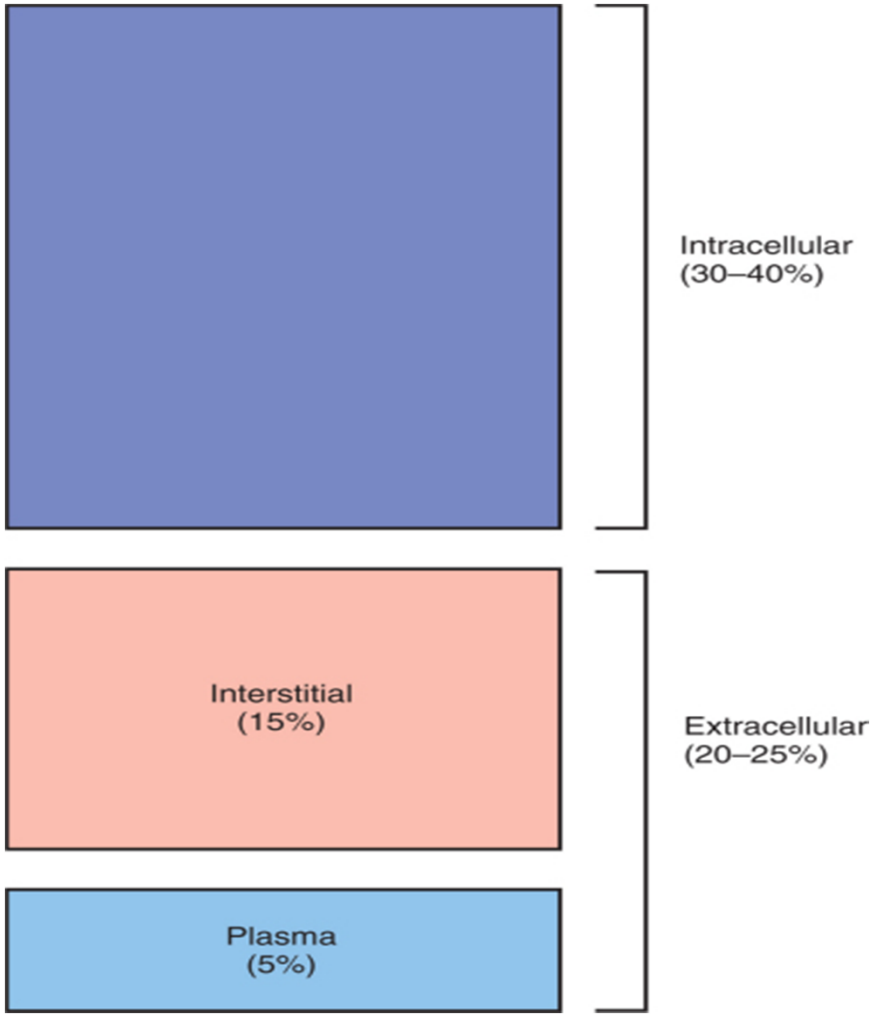
Learning Objectives

- Calculate maintenance fluid requirements based on an understanding of body water composition and electrolyte physiology
- Identify symptoms of dehydration and calculate degree of deficit
- Identify electrolyte composition of different body fluids and corresponding replacement fluid type

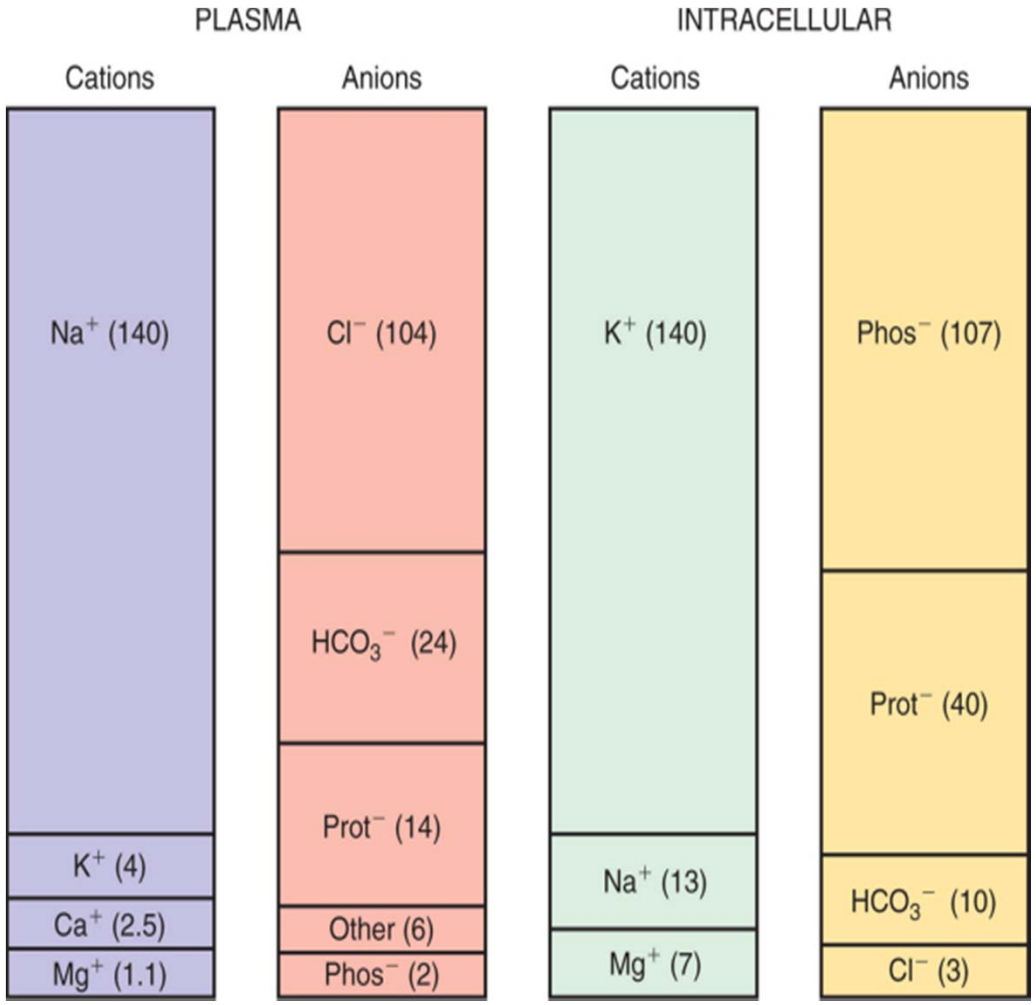
Total Body Water Composition



- Regulated by Anti-diuretic hormone (ADH) and aldosterone
- Are secreted in reaction changes in blood volume
- Disturbances in either ADH or aldosterone will cause large effects on water homeostasis

Electrolyte Composition of Intra and Extracellular Fluids

- Sodium is the predominant cation in the extracellular space
- Alterations in sodium concentrations can have significant effects on water homeostasis
- Potassium is the predominant intracellular cation
- Medical conditions and drugs can cause movement in potassium from the intracellular to extracellular space



Intravenous Fluid Composition

Fluid	Na	Cl	K	Ca	Lactate
Normal Saline (0.9%)	154meq	154meq			
½ Normal Saline (0.45%)	77meq	77meq			
1/4 Normal Saline (0.2%)	34meq	34meq			
Lactated Ringers	130meq	109meq	4meq	3meq	28meq

Osmolality

Osmolality = 2 × [Na] + [glucose]/18 + [BUN]/2.8

- Measure of solute particles per weight of solvent
- Normal ranges are 280-295 mOsm/kilogram
- Water shifts from a low to high osmolality in the body
- Rapid shifts adversely effect the central nervous system more than the rest of the body as seen to the right with central pontine myelinosis -→

Goals of Maintenance Fluids

Fluid Goals

- Prevent **Dehydration**
- Prevent **Electrolyte Disorders**
- Prevent **Ketoacidosis***

* Guidelines assume that there is no disease process present that would require an adjustment in either the volume or the electrolyte composition of the maintenance fluids

- Infants and children require more fluids per unit of body weight due to high metabolic rates
- Maintenance fluids should be initiated for infants who are required to go over 4 hours without fluid intake- as occurs prior to surgery and procedures

- Maintenance fluids replace the daily loss of: **urine+ stool+ insensible losses**

Maintenance IV Fluids: Holliday Segar Method of Calculation

- What to run?

<10kg:

D5 ¼ NS + 10meqKCl/L

>10kg:

D5 ½ NS + 20meq KCl/L

How much ml/day?

1st 10 kg: 100ml/kg

2nd 10 kg: 50ml/kg

kg >20kg: 20ml/kg

How fast ml/hr?

1st 10 kg: 4ml/kg

2nd 10 kg: 2ml/kg

kg >20 kg: 1ml/kg

Maintenance IVF Practice:

Write hourly rates for each patient weight

8 kg = 8 x 4 = 32cc per hour- D5 1/4

10kg = 10 x 4 = 40cc per hour- either ½ or1/4

15kg = 10x 4 + 5 x 2= (40 + 10)= 50cc/hr- D5 ½

80kg = 10x 4 + 10x 2 +60x 1= (40+20+60)= 120cc

Note- 120cc is maximal rate for normal maintenance

In oncology patients meters squared is used in lieu of kilograms

Clinical Picture of Dehydration

Signs & Symptons	Mild 3-5%	Moderate 6-9%	Severe > 10%
General	Thirsty, restless, alert	Drowsy	Drowsy, limp, cold, mottled
Peripheral pulses	Normal	Rapid and weak	Rapid, thready
Breathing	Normal	Deep, rapid	Deep, rapid
Fontanelle	Normal	Sunken	Very sunken
Capillary Refill	< 2 Seconds	Prolonged 3-4 sec	Very prolonged > 4 sec
Mucous membrane	Moist	Dry	Very dry
Blood Pressure	Normal	Normal	Hypotension

Fluid Resuscitation/Treatment of Dehydration

- For dehydration,shock,blood loss-isotonic
- **Normal Saline or Lactated Ringers**
- Give 20ml/kg as bolus….then repeat your exam
- Repeat bolus if symptoms of dehydration are still present
- After patient shows improvement you can change to glucose containing IV fluids
- Calculate fluid need based on degree of dehydration and cover for 24 hours
- Consider Colloid for large blood loss or greater than 3 boluses of 20cc/kg

Electrolyte Composition of Body Fluids

Fluid	Replacement of ongoing fluid loss	Replacement rate
Gastric fluid **Na 60 meq/L** **K 10 meq/L** **Cl 90 meq/L**	**Normal Saline + 10 meq KCL/Liter**	**ml/ml every 1-6 hours**
Diarrhea **Na 55meq/L** **K 25meq/L** **HCO3 meq15/L**	**D5 ¼ NS +** **NaHCO3 20 meq/L +** **KCL 20 meq/L**	**ml/ml every 1-6 hours**

Intern Case

History

You are receiving an admission from the same day sick clinic. It is a 2 month old with vomiting and diarrhea for 3 days. Failed oral rehydration therapy due to vomiting. Two days ago the patient was seen for the same symptoms- weight at that time was 5500 grams. Today you are told the weight is 5000 grams.

Questions

1. What is the degree of dehydration?
2. What would be the fluid deficit of this child in cc?
3. What is the maintenance IV rate?
4. What would be your initial fluid order?
5. What vital signs would you expect initially?
6. Write admission orders for this child

Senior Level Case

You are covering the oncology service overnight. A nurse calls to report that a 2 year old with recently diagnosed ALL has not urinated for 8 hours. He has been on no IV fluids and has oral lesions due to recent chemotherapy.

This child has Down's Syndrome and a "large" VSD and is on lasix and digoxin. You have no recent laboratory work available.

What potential electrolyte abnormalities do you expect on a chemistry?

What underlying pathology in this child could cause potential complications in fluid resuscitation?

What would be your initial fluid order to the nurse and why?

What physical exam findings would be helpful in your decision?

What ominous physical signs would you look for after initial treatment?

Take Home Points!

- Maintenance fluid calculations are based on the composition of maintenance water and use the Holiday Segar, or 4:2:1 method
- Dehydration can be a medical emergency. Identification of the degree of deficit is based on patient history and physical signs on exam. Fluid resuscitation should be with isotonic fluid.
- Correction of ongoing fluid losses is based on the body fluid lost and should be added to maintenance fluid requirements

Bibliography

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- 2. Zaoutis L., Chiang V. *Comprehensive Pediatric Hospital Medicine.* Mosby;2007
- 3. Pediatric Hospital Medicine Core Competencies