FLUIDS AND ELECTROLYTES (4) / GASTROINTESTINAL SYSTEM (9) / RENAL SYSTEM (14)
FLUID AND ELECTROLYTES - WATER

Metabolism 10%
Foods 30%
Beverages 60%

Average intake per day:
- Metabolism: 250 ml
- Foods: 750 ml
- Beverages: 1500 ml

Total intake: 2500 ml

Average output per day:
- Urine: 1500 ml
- Feces: 100 ml
- Sweat: 200 ml
- Insensible losses via skin and lungs: 700 ml

Total output: 2500 ml
Where does the water in the body come from?

How is water lost?
Quantify the intake and output.
Overview of fluid electrolyte balance

http://www.youtube.com/watch?v=1fvHXMfopito&feature=related
Fluid and electrolytes – Water

Fluid Compartments

Intracellular fluid (ICF) – contained in cells

Extracellular fluid (ECF) – consists of two major subdivisions

*Plasma* – the fluid portion of the blood

*Interstitial fluid (IF)* – fluid in spaces between cells

*Other ECF* – lymph, cerebrospinal fluid, eye humors, synovial fluid, serous fluid, and gastrointestinal secretions
FLUID AND ELECTROLYTES – DISORDERS OF FLUID BALANCE

- Hypovolemia
  - Seen in:
    - Diabetes
    - Dehydration
    - Hemorrhage
    - Vomiting/Diarrhea
  - S & S:
    - Orthostatic hypotension
    - Tachycardia
    - Thirst
  - Tx:
    - Oral or parenteral fluids

- Hypervolemia
  - Seen in:
    - Cirrhosis
    - Heart failure
    - Low dietary protein
    - Renal failure
  - S & S:
    - Hypertension
    - Bounding pulse
    - Dyspnea
    - Acute weight gain
  - Tx:
    - Sodium and water restriction
    - Diuretic
## Fluids and Electrolytes - Edema

Fluid accumulation in the interstitial spaces

<table>
<thead>
<tr>
<th>Cause</th>
<th>Underlying Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoproteinemia</td>
<td>Cirrhosis</td>
</tr>
<tr>
<td></td>
<td>Malnutrition</td>
</tr>
<tr>
<td>Increased endothelial permeability</td>
<td>Inflammatory or immunologic reactions</td>
</tr>
<tr>
<td></td>
<td>Burns</td>
</tr>
<tr>
<td></td>
<td>Trauma</td>
</tr>
<tr>
<td>Increased hydrostatic pressure</td>
<td>Cirrhosis</td>
</tr>
<tr>
<td></td>
<td>Heart Failure</td>
</tr>
<tr>
<td></td>
<td>Venous thrombosis</td>
</tr>
<tr>
<td>Lymphatic obstruction</td>
<td>Cancer</td>
</tr>
<tr>
<td></td>
<td>Scarring</td>
</tr>
<tr>
<td>Sodium retention</td>
<td>Excessive salt intake</td>
</tr>
</tbody>
</table>
FLUID AND ELECTROLYTES

- Sodium Na+
- Chloride Cl-
- Hydrogen H+
- Bicarbonate HCO$_3^-$
- Calcium Ca++
- Potassium K+
- Sulfate SO$_4^{2-}$
- Magnesium Mg++
- Phosphate PO$_4^{3-}$
<table>
<thead>
<tr>
<th>Electrolyte imbalance (decrease)</th>
<th>Signs &amp; Symptoms</th>
</tr>
</thead>
</table>
| Hyponatremia                      | Weakness, Nausea, Vomiting, Abdominal cramps  
Confusion, Seizures, Coma |
| Hypokalemia                      | Weakness, Fatigue, Nausea, Vomiting, Leg cramps, Dizziness  
Arrhythmias, Cardiac arrest |
| Hypochloremia                    | Hypertonicity and tetany, muscle twitching  
Shallow, depressed breathing |
| Hypocalcemia                     | Anxiety, irritability, Seizures, Hypotension, arrhythmias |
| Hypomagnesemia                   | Hyperiirritability, tetany leg and foot cramps  
Confusion, delusions, Seizures  
Arrhythmias, hypotension |
| Hypophosphatemia                 | Weakness, tremor, paresthesias |
## Electrolyte Imbalances

<table>
<thead>
<tr>
<th>Electrolyte Imbalance (increase)</th>
<th>Signs &amp; Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypernatremia</td>
<td>Agitation, restlessness, hypertension, pitting edema, tachycardia, thirst, dyspnea, respiratory arrest</td>
</tr>
<tr>
<td>Hyperkalemia</td>
<td>Nausea, diarrhea, abdominal cramps, muscle weakness, Tachycardia....bradycardia....cardiac arrest</td>
</tr>
<tr>
<td>Hyperchloremia</td>
<td>Deep rapid breathing, weakness, dimished cognitive ability....coma</td>
</tr>
<tr>
<td>Hypercalcemia</td>
<td>Anorexia, nausea, vomiting, dehydration, Drowsiness, lethargy, headaches, irritability, confusion, depression, weakness</td>
</tr>
<tr>
<td>Hypermagnesemia</td>
<td>rare</td>
</tr>
<tr>
<td>Hyperphosphatemia</td>
<td>asymptomatic</td>
</tr>
</tbody>
</table>
FLUIDS AND ELECTROLYTES – ACID-BASE BALANCE

- 7.35 – 7.45 = NORMAL blood pH
GASTROINTESTINAL SYSTEM

- Mouth
- Salivary Glands
- Liver
- Billiary Duct
- Pancreas
- Anus
**SALIVARY GLANDS**
Secretion of lubricating fluid containing enzymes that break down carbohydrates

**LIVER**
Secretion of bile (important for lipid digestion), storage of nutrients, many other vital functions

**GALLBLADDER**
Storage and concentration of bile

**PANCREAS**
Exocrine cells secrete buffers and digestive enzymes; endocrine cells secrete hormones
GASTROINTESTINAL SYSTEM

Mouth

Nutrients into bloodstream

Elimination of waste products

Anus

Amino acids
Glucose
Fatty Acids
Water
Minerals
**ORAL CAVITY, TEETH, TONGUE**
Mechanical processing, moistening, mixing with salivary secretions

**PHARYNX**
Pharyngeal muscles propel materials into the esophagus

**ESOPHAGUS**
Transport of materials to the stomach

**STOMACH**
Chemical breakdown of materials via acid and enzymes; mechanical processing through muscular contractions

**LARGE INTESTINE**
Dehydration and compaction of undigestible materials in preparation for elimination

**SMALL INTESTINE**
Enzymatic digestion and absorption of water, organic substrates, vitamins, and ions
Digestion
SIGNS AND SYMPTOMS ASSOCIATED WITH GI TRACT DISFUNCTION

- **Anorexia**: Loss of appetite from slow gastric emptying
- **Constipation**: Hard stools or infrequent defecation
- **Diarrhea**: Frequent defecation and/or increase in fluidity or volume of feces
- **Dysphasia**: Difficulty swallowing
- **Jaundice**: Yellow pigmentation of the skin, sclera, hard palate, palmar and plantar surfaces, from a bilirubin level >2.0
- **Nausea**: Urge to vomit
- **Vomiting**: Forceful oral expulsion of gastric content
Hunger

- Contraction of an empty stomach
- Decreased blood glucose
- Distention of the stomach
- Increased blood fat or amino acids
JAUNDICE

Excess accumulation of bilirubin in the blood

Hepatic Jaundice

Drugs
Hepatitis
Cirrhosis
Cancer

Hemolytic Jaundice \([RBC \text{ lysis exceeds liver’s ability to conjugate bilirubin (bind to it and excrete it)}]\)

Obstructive Jaundice (flow of bile out of liver is blocked from entering the small intestine)

Gallstone
Hepatic duct stone or tumor

Transfusion reaction
Sickle Cell Anemia
Thalassemia
DIARRHEA

Presence of unabsorbed substances
(osmotic diarrhea from synthetic sugars)

Parasympathetic stimulation

Water in colon

Drugs

Intestinal Motility
(Inflammation, Neuropathy)

Intestinal secretions (cholera)
Constipation

Drugs (antacids, opiates)

Stress

Frequent suppression of defecation

Hypothyroidism

Dehydration

Low Fiber Diet

Sedentary Lifestyle
VOMITING

Increased abdominal pressure

Forceful contraction of the diaphragm

Relaxation of the gastroesophageal sphincter

Impairment of the vomiting control centers in the Medulla
COMMON DISORDERS OF THE GASTROINTESTINAL TRACT
APPENDICITIS

- Inflammation and obstruction of the vermiform appendix
- The most common disease requiring emergency surgery
SIGNS AND SYMPTOMS OF APPENDICITIS

- Abdominal pain starting in peri-umbilical region and shifting to the right lower quadrant
- Anorexia
- Nausea and vomiting
- Low-grade fever
- High WBC count
TREATMENT OF APPENDICITIS

- Surgery (appendectomy)
CHOLECYSTITIS

- Distention of the gallbladder, usually associated with gallstones in the cystic duct.
SIGN AND SYMPTOMS OF CHOLECYSTITIS

- Right upper quadrant pain that may radiate to:
  - Back
  - Between shoulders
  - Front of chest
- Colicky pain
- Nausea and vomiting
- Chills
- Low-grade fever

- Alkaline phosphate, lactate dehydrogenase, aspartate aminotransferase, total bilirubin are all high
- Ultra sound/X-ray: gallstones
TREATMENT OF CHOLECYSTITIS

- Surgery (cholecystectomy)
- Low fat diet
DIVERTICULAR DISEASE

- Pouches of GI mucosa that bulge through the surrounding muscle
The diverticulum becomes infected.
SIGNS AND SYMPTOMS OF DIVERTICULITIS

Mild Diverticulitis

- Left-sided abdominal pain
- Low-grade fever
- Leukocytosis
Severe Diverticulitis

- Abdominal rigidity
- Left lower quadrant pain
- High fever
- Chills
TREATMENT OF DIVERTICULOSIS

- High fiber diet
- Exercise
- Resist straining when defecating
TREATMENT OF DIVERTICULITIS - MILD

- Liquid or bland diet
- Stool softeners
- Antibiotics
TREATMENT OF DIVERTICULITIS - SEVERE

- Surgery (Colon resection)
GASTROESOPHAGEAL REFLUX

- Backflow of gastric or duodenal content into the esophagus
**SIGNS AND SYMPTOMS OF GASTROESOPHAGEAL REFLUX DISEASE**

- Burning pain in the epigastric area, radiating to the arms and chest
- Usually occurs:
  - after a meal
  - after lying down
TREATMENT OF GASTROESOPHAGEAL REFLUX

- Frequent, small meals
- Sitting up during meals
- No meals at least 2 – 3 hours before bedtime
- D/C smoking
- Prevent increased intra-abdominal pressure (bending, tight clothing, obesity)
- Elevation of head of bed
- Antacids
- Proton pump inhibitor
HEMORRHOIDS

- Dilation of hemorrhoidal veins:
  + Superior plexus above the dentate line: *Internal* Hemorrhoids
  + Inferior plexus below the dentate line: *External* Hemorrhoids
SIGNS AND SYMPTOMS OF HEMORRHOIDS

- Painless intermittent bleeding during defecation
- Bright red blood on stool or toilet tissue
- Anal itching
TREATMENT OF HEMORRHoids

- Local anesthetic
- Hydrocortisone cream/suppositories
- Warm sitz baths
- Prevent constipation by eating a high-fiber diet and increase fluid intake
- Avoid prolonged sitting
- Avoid straining at defecation
- Loose weight if obese
Inflammation of the liver from a variety of causes:

- Autoimmune
- Chemicals (i.e. acetaminophen, sulfonamides, niacin)
- Infectious organisms (Viral Hepatitis A, B, C, D, E)
<table>
<thead>
<tr>
<th>Transmission</th>
<th>Hepatitis A</th>
<th>Hepatitis B</th>
<th>Hepatitis C</th>
<th>Hepatitis D</th>
<th>Hepatitis E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecal-oral</td>
<td>Fecal-oral (oral/anal)</td>
<td>Parenteral</td>
<td>Parenteral</td>
<td>Parenteral</td>
<td>Fecal-oral</td>
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<tr>
<td>Sexual</td>
<td>Sexual</td>
<td>Sexual</td>
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<tr>
<td>Maternal-</td>
<td>Maternal-neonatal</td>
<td>Maternal-neonatal</td>
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<td></td>
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<tr>
<td>neonatal From all</td>
<td>body fluids</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Severity</td>
<td>Mild</td>
<td>Mild to severe</td>
<td>Moderate</td>
<td>Severe</td>
<td>Severe</td>
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<tr>
<td>Progression to</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>chronicity</td>
<td></td>
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</tbody>
</table>
PREVENTION OF INFECTIOUS HEPATITIS

- Hand washing
- Prevent contamination of water and food
- No sharing of utensils or toothbrushes with infected person
- No sexual contact with an infected person
SIGNS AND SYMPTOMS OF HEPATITIS

- Anorexia
- Nausea/Vomiting
- Jaundice
- Dark urine
- Clay-colored stool
- Right upper quadrant pain
- Pruritis
- Fatigue
- Aversion to smoking

- Elevated liver enzymes and bilirubin levels
- Elevated white blood cells
- If infectious, antibodies against Hepatitis A,B,C,D,E
TREATMENT OF HEPATITIS

- Rest
- Small, high calorie, meals
- Encourage fluid intake or use IV fluids
CIRRHOSIS

- Necrosis of liver cells
- Seen in chronic alcoholism, and chronic hepatitis B, C
SIGNS AND SYMPTOMS OF CIRRHOSIS

- Early Cirrhosis
  + Anorexia
  + Nausea and vomiting
  + Diarrhea
  + Dull abdominal pain
  + Weakness
  + Fatigue
SIGNS AND SYMPTOMS OF CIRRHOSIS

- Late Cirrhosis
  + Bleeding tendencies
  + Jaundice
  + Spider angiomas
  + Palmar erythema
  + Severe Pruritis
  + Ascites
  + Pitting edema
What are the functions of the liver.

http://www.youtube.com/watch?v=RsPzlqcVaoY&feature=fvwrel
Lesions in the mucosa of the esophagus, stomach, pylorus, duodenum (80%), or jejunum

Caused by infection with H.Pylori, NSAIDs, Tobacco, Alcohol, coffee, stress
SIGNS AND SYMPTOMS OF PEPTIC ULCERS

- Epigastric pain (made worse with food in gastric ulcer, and improved with food in duodenal ulcer; improved with antacids)
- Nausea
TREATMENT OF PEPTIC ULCERS

- Antimicrobials against H. Pylori
- Proton pump inhibitor
- Avoidance of alcohol and coffee, and smoking
- Avoid NSAIDs
- Stress management
- Small meals
RENAL SYSTEM
Front View of Urinary Tract

- Kidney
- Ureter
- Bladder
- Sphincter
- Urethra
From Circulation

Artery

To Circulation

Vein

Proteins, nutrients, water, and some ions returned to blood.

Filtration & Dialysis

All blood components enter kidney.

Wastes and controlled amounts of water and ions excreted.

Ureter

To Bladder
http://www.youtube.com/watch?v=XF_IF3J4ZKs&NR=1
Overview of the urinary system
ACUTE PYELONEPHRITIS

- Acute bacterial infection of the kidneys
- Risks:
  + Untreated cystitis
  + Diabetes
- S & S:
  + Fever
  + Chills
  + Flank pain
  + Fatigue
- Tx:
  + Antibiotics, oral or parenteral
  + Increase fluids, orally or IV
ACUTE RENAL FAILURE

- Sudden interruption in renal function
- S & S:
  - Oliguria (low output of urine)
  - Hypotension.......Hypertension
  - Nausea/Vomiting/Anorexia
  - Pruritis
  - Muscle weakness
  - Altered mental status
http://www.youtube.com/watch?v=lzVAJN_ENFGs&NR=1
Overview of Acute Kidney Failure
CHRONIC RENAL FAILURE

- Causes:
  - Chronic glomerular disease
  - Chronic pyelonephritis
  - Diabetes
  - Hypertension

- S & S:
  - Fatigue
  - Nausea
  - Hypertension
  - Yellow-bronze skin
http://www.youtube.com/watch?v=IvHJmfxGj8s
Overview of chronic kidney failure
Glomerulonephritis

- Inflammation of the glomeruli, typically following a streptococcal infection [Streptococcal infection of the throat (strep throat) or skin (impetigo)]

- S & S:
  + Oliguria
  + Hematuria
  + Periorbital edema
  + Hypertension
RENAL CALCULI (NEPHROLITHIASIS)

- Stones which form in the urinary tract, principally in the renal calyces.
- Risks:
  - Dehydration
  - Gout
  - Chronic infection
  - Change in urine pH
RENAL CALCULI (NEPHROLITHIASIS)

S & S:
- Severe, colicky flank pain
- Nausea/Vomiting
- Hematuria

Tx:
- Hydration, oral or IV, to more than 3 quarts/day
- Analgesic
- Strain/Cystoscope/Lithotripsy/Surgery
The pH of the urine influences the types of calculi that may form.

- Urine pH that fails to fluctuate, remaining consistently acidic or alkaline
  - Medium that is suitable for calculi formation
    - Acidic urine: Formation of cystine calculi and uric acid calculi
    - Varying pH: Formation of calcium oxalate calculi
    - Alkaline urine: Formation of calcium phosphate calculi and magnesium ammonium phosphate calculi