- Chapter 21
- Kidney Disease
- Chapter 21

Lesson 21.1

- Key Concepts
- Kidney disease interferes with the normal capacity of nephrons to filter waste products of body metabolism.
- Key Concepts, cont'd
- Short-term kidney disease requires basic nutrition support for healing rather than dietary restriction.
- Kidney Disease
- 3.8 million Americans have some form of kidney disease.
- 42,000 persons die from such diseases each year.
- Kidney Disease, cont'd
- Dual Role of the Kidneys
- Kidneys make urine, through which they excrete most of the waste products of metabolism.
- Kidneys control the concentrations of most constituents of body fluids, especially blood.
- Basic Structure and Function
- Structures
  - Basic unit is the nephron
    - Glomerulus

- Tubules

- Function
  - Excretory and regulatory
  - Endocrine
- Basic Structure
- Renal Nephrons
- Basic functional unit of the kidney
- Major nephron functions
  - Filtration of materials in blood
  - Reabsorption of needed substances
  - Secretion of hydrogen ions to maintain acid-base balance
  - Excretion of waste materials
- Additional functions
  - Renin secretion (for body water balance)
  - Erythropoietin secretion (for red cell production)
  - Vitamin D activation
- Nephron Structures
- Glomerulus
  - Cluster of branching capillaries
  - Cup-shaped membrane at the head of each nephron forms the Bowman's capsule
  - Filters waste products from blood
  - Glomerular filtration rate: Preferred method of monitoring kidney function
- Tubules
  - Proximal tubule
  - Loop of Henle

- Distal tubule
- Collecting tubule

- Tubules
- Causes of Kidney Disease
- Infection and obstruction
- Damage from other diseases
- Toxins
- Genetic defect
- Risk factors

- Causes of Kidney Disease, cont'd
- Risk Factors and Causes of Kidney Disease
- Sociodemographic factors
  - Older age
  - Racial or ethnic minority status
  - Exposure to certain chemical and environmental conditions
  - Low income or education
- Risk Factors and Causes of Kidney Disease, cont'd
- Clinical factors
  - Poor glycemic control in diabetes
  - Hypertension
  - Autoimmune disease

- Systemic infections
- Urinary tract infections
- Urinary stones

- Risk Factors and Causes of Kidney Disease, cont'd
- Clinical factors
  - Lower urinary tract obstruction
  - Neoplasia
  - Family history of chronic kidney disease
  - Recovery from acute kidney failure
  - Reduction in kidney mass
  - Exposure to certain nephrotoxic drugs
  - Low birth weight
  - From Eknoyan G, Levin NW: K/DOQI clinical practice guidelines for chronic kidney
  - disease: evaluation, classification, and stratification, Am J Kidney Dis 39(2 suppl):1; 2002.
  - Copyright National Kidney Foundation.

- Medical Nutrition Therapy
- Based on the nature of the disease process and individual responses
  - Length of disease
    - Long term: More specific nutrient modifications
  - Degree of impaired renal function
    - Extensive: Extensive nutrition therapy required
  - Individual clinical symptoms

- Acute Glomerulonephritis or Nephritic Syndrome

- **Clinical symptoms: Hematuria, proteinurea, edema, mild hypertension, depressed appetite, possible oliguria or anuria**
- **Acute Glomerulonephritis or Nephritic Syndrome, cont'd**
- **Medical Nutrition Therapy**
- **Acute glomerulonephritis**
  - **Uncomplicated disease: Antibiotics and bed rest**
  - **Advanced disease:**
    - **Possible restriction of protein, sodium**
    - **Liberal intake of carbohydrates**
    - **Potassium intake may be monitored**
    - **Fluid intake may be restricted**

- **Nephrotic Syndrome**
- **Clinical symptoms: Massive edema, ascites, proteinurea, distended abdomen, reduced plasma protein level, body tissue wasting**
- **Medical Nutrition Therapy**
- **Nephrotic syndrome**
  - **Protein intake to meet nutrition/growth needs (without excess)**
  - **Carbohydrate**
  - **Lipids**
  - **Sodium (~3 g/day)**
  - **Potassium**
  - **Water**

- Other minerals and vitamins

- Chapter 21

Lesson 21.2

- Key Concepts

- The progressive degeneration of chronic renal failure requires dialysis treatment and modification according to individual disease status.

- Key Concepts, cont'd

- Current therapy for renal stones depends more on basic nutrition and health support for medical treatment than on major food and nutrient restrictions.

- Kidney Disease

- 3.8 million Americans have some form of kidney disease.

- 42,000 persons die from such diseases each year.

- Acute Kidney Failure

- Prerenal

- Intrinsic

- Postrenal obstruction

- Acute Renal Failure

- Clinical symptoms: Oliguria, proteinurea, hematuria, loss of appetite, nausea/vomiting, fatigue, edema, itchy skin

- Short-term dialysis may be needed

- May progress to chronic renal failure

- Medical Nutrition Therapy
- Acute kidney failure
  - Goal is to improve or maintain nutritional status
  - Parenteral nutrition therapy may be required
  - Recommendations for protein intake have been debated
  - Individualized therapy based on renal function (indicated by glomerular filtration rate)
- Medical Nutrition Therapy
- Chronic Kidney Failure
- Caused by progressive breakdown of renal tissue, which impairs all renal functions
- Develops slowly
- No cure (other than kidney transplant)
- Clinical symptoms: Polyuria/oliguria/anuria, electrolyte imbalances, nitrogen retention, anemia, hypertension, azotemia, weakness, shortness of breath, fatigue, thirst, appetite loss, bleeding, muscular twitching
- Medical Nutrition Therapy Objectives
- Reduce protein breakdown
- Avoid dehydration or excess hydration
- Correct acidosis
- Correct electrolyte imbalances
- Control fluid and electrolyte losses
- Maintain optimal nutritional status
- Maintain appetite and morale
- Control complications of hypertension, bone pain, nervous system involvement
- Slow rate of renal failure

- Medical Nutrition Therapy Principles
- Provide enough protein therapy to maintain tissue integrity while avoiding excess
- Provide amino acid supplements for protein supplementation
- Reserve protein for tissue synthesis by ensuring adequate carbohydrates and fats
- Maintain adequate urine volume with water
- (Possibly) restrict sodium, phosphate, calcium
- Supplement diet with multivitamin
- Stages of Chronic Kidney Disease
- End-Stage Kidney Disease
- Occurs when patient's glomerular filtration rate decreases to 15 ml/min
- Irreversible damage to most nephrons
- Dialysis or transplant are only options
- Hemodialysis
- Uses an artificial kidney machine to remove toxic substances from blood, restore nutrients and metabolites
- Two to three treatments per week typically required
- Patient's blood makes several "round trips" through machine
- Dialysis solution (dialysate) removes excess waste material
- Hemodialysis, cont'd
- Hemodialysis, cont'd
- Hemodialysis Patient
- Medical nutrition therapy

- Maintain protein and energy balance
- Prevent dehydration or fluid overload
- Maintain normal serum potassium and sodium levels
- Maintain acceptable phosphate and calcium levels

- Hemodialysis Patient, cont'd
- Other dietary concerns
  - Avoid protein energy malnutrition by careful calculation of protein allowance
  - Maintain body mass index of 25 to 28 kg/m2
  - Fluid intake: 1000 ml/day, plus amount equal to urine output
  - Sodium: 2000 mg/day
  - Potassium: 2000-3000 mg/day
  - Supplement of water-soluble vitamins (e.g., B complex, C)
- Peritoneal Dialysis
- Performed at home
- Patient introduces dialysate solution directly into peritoneal cavity four to five times per day
- Surgical insertion of permanent catheter is required
- Disposable bag containing dialysate solution is attached to catheter
- Diet is more liberal than with hemodialysis
- Peritoneal Dialysis, cont'd
- Peritoneal Dialysis, cont'd
- Peritoneal Dialysis, cont'd

- **Medical nutrition therapy**
  - **Increase protein intake to 1.2 to 1.5 g/kg body weight**
  - **Increase potassium with a wide variety of fruits and vegetables**
  - **Encourage liberal fluid intake of 1500 to 2000 ml/day**
  - **Avoid sweets and fats**
  - **Maintain lean body weight**

- **Comorbid Conditions**
- **Osteodystrophy**
  - **Bone disease resulting from defective bone formation**
  - **Found in about 40% of patients with decreased kidney function and 100% of patients with kidney failure**
- **Neuropathy**
  - **Central and peripheral neurologic disorders**
  - **Found in up to 65% of patients at the initiation of dialysis**
- **Kidney Stones**
- **Basic cause is unknown**
- **Factors relating to urine or urinary tract environment contribute to formation**
- **Present in 5% of U.S. women and 12% of U.S. men**
- **Major stones are formed from one of three substances:**
  - **Calcium**
  - **Struvite**
  - **Uric acid**

- Kidney Stones, cont'd
- Risk Factors
- Calcium Stones
- 70% to 80% of kidney stones are composed of calcium oxalate
- Almost half result from genetic predisposition
- Other causes
  - Excess calcium in blood (hypercalcemia) or urine (hypercalciuria)
  - Excess oxalate in urine (hyperoxaluria)
  - Low levels of citrate in urine (hypocitraturia)
  - Infection
- Examples of Food Sources of Oxalates
- Fruits: Berries, Concord grapes, currants, figs, fruit cocktail, plums, rhubarb, tangerines
- Vegetables: Baked/green/wax beans, beet/collard greens, beets, celery, Swiss chard, chives, eggplant, endive, kale, okra, green peppers, spinach, sweet potatoes, tomatoes
- Nuts: Almonds, cashews, peanuts/peanut butter
- Beverages: Cocoa, draft beer, tea
- Other: Grits, tofu, wheat germ
- Struvite Stones
- Composed of magnesium ammonium phosphate
- Mainly caused by urinary tract infections rather than specific nutrient
- No diet therapy is involved
- Usually removed surgically

- Other Stones
- Cystine stones
  - Caused by genetic metabolic defect
  - Occur rarely
- Xanthine stones
  - Associated with treatment for gout and family history of gout
  - Occur rarely
- Kidney Stones: Symptoms and Treatment
- Clinical symptoms: Severe pain, other urinary symptoms, general weakness, fever
- Several considerations for treatment
  - Fluid intake to prevent accumulation of materials
  - Dietary control of stone constituents
  - Achievement of desired pH of urine with medication
  - Use of binding agents to prevent absorption of stone elements
  - Drug therapy in combination with diet therapy
- Nutrition Therapy:
  Calcium Stones
- Low-calcium diet (~400 mg/day) recommended for those with supersaturation of calcium in the urine and who are not at risk for bone loss
- If stone is calcium phosphate, sources of phosphorus (e.g., meats, legumes, nuts) are controlled
- Fluid intake increased
- Sodium intake decreased
- Fiber foods high in phytates increased
- Nutrition Therapy:
  Uric Acid Stones

- Low-purine diet sometimes recommended
- Avoid:
  - Organ meats
  - Alcohol
  - Anchovies, sardines
  - Yeast
  - Legumes, mushrooms, spinach, asparagus, cauliflower
  - Poultry
- Medical Nutrition Therapy:
  Cystine Stones
- Low-methionine diet (essentially a low-protein diet) sometimes recommended
- In children, a regular diet to support growth is recommended
- Medical drug therapy is used to control infection or produce more alkaline urine
- General Dietary Principles: Kidney Stones
- Summary
- The nephrons are the functional units of the kidneys. Through these unique structures the kidney maintains life-sustaining blood levels of materials required for life and health.
- The nephrons accomplish their tremendous task by constantly "laundering" the blood many times each day, returning necessary elements to the blood and eliminating the remainder in concentrated urine.
- Summary, cont'd
- Various diseases that interfere with the vital function of nephrons can cause kidney disease.
- At its end stage, chronic kidney disease is treated by dialysis or kidney transplantation.

- **Dialysis patients require close monitoring for protein, water, and electrolyte balance.**

- **Summary, cont'd**
- **Kidney diseases have predisposing factors (e.g., recurrent urinary tract infections may lead to renal calculi, and progressive glomerulonephritis may lead to chronic nephrotic syndrome and kidney failure).**
- **Kidney stones may be formed from a variety of substances. For some patient, a change in dietary intake of the identified substance (e.g. fluid, sodium, oxalate, purine) may decrease stone formation.**