# Chapter 21 : Nutrition for Patients with Kidney Disorders

# Kidney Functions

- Maintain normal blood volume and composition
  - By reabsorbing needed nutrients and excreting wastes through urine
- Blood pressure regulation through the action of **rennin**
- RBC production through the action of **erythropoietin** **(**stimulates the bone marrow to produce red blood cells)

# Kidney Functions

- help to regulate acid–base balance
  - by secreting **hydrogen ions** to increase pH and excreting **bicarbonate** to lower pH

- Maintaining normal metabolism of calcium and phosphorus.
  - Because vitamin D is converted to its active form in the kidneys

# Kidney Disorders

- NEPHROTIC SYNDROME
- CHRONIC KIDNEY DISEASE
- ACUTE RENAL FAILURE
- KIDNEY STONES

# NEPHROTIC SYNDROME

- A collection of symptoms that occurs when **increased capillary permeability** in the glomeruli → allows serum proteins to leak into the urine.

- Major symptoms :
  - Proteinuria
  - Hypoalbuminemia
  - Hyperlipidemia (because of increased hepatic lipogenesis)
  - Edema

# NEPHROTIC SYNDROME

- Causes :
  - Diabetes
  - Autoimmune diseases (e.g., lupus, IgA nephropathy)
  - Infection
  - certain chemicals and medications

# Nutrition Therapy

- The goals of nutrition therapy are to :
  - minimize edema, proteinuria, and hyperlipidemia;
  - replace nutrients lost in the urine;
  - and reduce the risk of progressive renal damage and atherosclerosis.

# Nutrition Therapy

- A mild **protein "restriction"** of 0.8 to 1.0 g/kg of body weight

- Along with the use of an angiotensin-converting enzyme (ACE) inhibitor
  - decreases urinary protein losses

## Nutrition Therapy for Nephrotic Syndrome

| Dietary Component | Recommendation | Rationale |
|---|---|---|
| Protein | 0.8–1.0 g/kg/day; soy protein may be more beneficial than animal proteins | To minimize proteinuria; soy protein may decrease proteinuria more than high–biologic value proteins |
| Calories | 35 cal/kg | To maintain weight and spare protein<br>A lower calorie intake to promote weight loss is recommended if blood pressure or hyperlipidemia are problems |
| Sodium | 1000–2000 mg | To help control edema; fluid restriction is generally not necessary |
| Fat and cholesterol | <30% of calories from total fat, <7% of calories from saturated fat, <200 mg cholesterol, and low trans fats | To improve hyperlipidemia<br>12 g of fish oil/day may be useful for IgA nephropathy |
| Vitamins and minerals | DRI amounts unless otherwise indicated | A multiple vitamin may be used to prevent nutrient deficiencies because many vitamins are bound to protein and are lost through proteinuria<br>Vitamin D and calcium are given if vitamin D is deficient<br>Iron is given if deficient |

# CHRONIC KIDNEY DISEASE (CKD)

- Syndrome of progressive kidney damage and loss of function.

- Over time, a decrease in the number of functioning nephrons overburdens the remaining nephrons
  - and the kidney's ability to filter blood deteriorates, as measured by a decrease in **glomerular filtration rate (GFR)**

## Classification of Chronic Kidney Disease Stages

| Stage | Description | GFR (mL/min/1.73 $m^2$) |
|---|---|---|
| 1 | Kidney damage with normal or increased GFR | ≥90 |
| 2 | Kidney damage with mildly decreased GFR | 60–89 |
| 3 | Moderately decreased GFR | 30–59 |
| 4 | Severely decreased GFR | 15–29 |
| 5 | Kidney failure | <15 or dialysis |

# CHRONIC KIDNEY DISEASE (CKD)

- For **stages 1 to 4:**
  - medical and nutrition therapy **can potentially delay the progression to stage 5.**

- Modifiable risk factors (reduce CKD damage) :
  - Smoking cessation
  - increase in physical activity
  - controlling blood lipid levels

- People with CKD that progresses to **stage 5** :
  - require dialysis or kidney transplant for survival.

# CKD : Causes

- Diabetes ( ~40% of cases).
- Cardiovascular disease
- Hypertension
- Obesity

# Impact on Nutrition

- As urine output decreases
  - fluid and electrolytes accumulate in the blood
    - producing symptoms of overhydration such as:
      - increased blood pressure
      - weight gain
      - Edema
      - shortness of breath
      - lung crackles

# Impact on Nutrition

- The retention of nitrogenous wastes leads to **uremic syndrome**.
  - **Uremic Syndrome:** a cluster of symptoms related to the retention of nitrogenous substances in the blood such as fatigue, decreased mental acuity, muscle twitches, cramps, anorexia, unpleasant nausea, vomiting, diarrhea, itchy skin, gastritis, and GI bleeding
- Acidosis occurs because the kidneys are unable to excrete excess acid produced through normal metabolic processes

# Impact on Nutrition

- Impaired synthesis of rennin can lead to
  - high blood pressure
- Impaired synthesis of Erythropoietin can lead to
  - Anemia
- Impaired synthesis of the active form of vitamin D can lead to:
  - bone demineralization

# Nutrition Therapy

- For stage 1-4 :
  - Protein is restricted to 0.6 – 0.75 g/kg
  - To reduce workload on the kidneys to delay or prevent further kidney damage

- For stage 5 (dialysis):
  - 50% more than the RDA
  - to account for the loss of serum proteins and amino acids in the **dialysate**.

# Nutrition Therapy

- High–biologic value proteins are emphasized
  - They provide **higher percentage of essential a.a →**
  - promote reuse of circulating nonessential amino acids for protein synthesis→
  - minimizes urea production

# Nutrition Therapy

- **Calories**
  - adequate calories to spare protein from being used for energy, enabling it to be used for protein synthesis.

- Clients who must limit their intake of protein may be advised to increase their intake of pure sugars and pure fats
  - to meet their calorie requirements while keeping protein intake low, even though they are not considered “nutritious.”

## QUICK BITE

Examples of pure sugars and pure fats

Pure sugars: cotton candy, fruit rollups, jelly beans, lollipops, marshmallows, honey, jam, maple syrup, sweetened beverages (within fluid allowance)

Pure fats: butter, margarine, mayonnaise, oils, shortening

# Nutrition Therapy

- **Sodium and Fluid**
  - Fluid is unrestricted in stages 1 to 4 with normal urine output.

- For people on hemodialysis:
  - Fluid allowance equals the volume of any urine produced plus 1000 mL.
  - **Should be taught how to control their intake and thirst is vital**

# STRATEGIES TO RELIEVE THIRST

- Use ice or popsicles within the fluid allowance—very cold things are better at relieving thirst.
- Suck on hard candy or mints.
- Chew gum.
- Rinse your mouth without swallowing using refrigerated water.
- Rinse your mouth occasionally with refrigerated mouthwash.
- Suck on a lemon wedge.
- Eat bread with applesauce or jelly with margarine.
- Control blood glucose levels, as appropriate.
- Try frozen low-potassium fruit, such as grapes.
- Use small glasses instead of large ones.
- Apply petroleum jelly to the lips.

# Phosphorus and Calcium

- In stages 1 to 4:
  - Phosphorus allowance is based on laboratory values
  - calcium is limited to 1000 to 1500 mg/day.

- A low phosphorus intake is relatively easy to achieve because protein intake is also restricted in these stages and protein and phosphorus share similar dietary sources.
- When dialysis :
  - protein allowance increases, phosphorus intake correspondingly increases

## Calcium, Phosphorus, and Protein Content of Selected Foods

| Item | Amount | Calcium (mg) | Phosphorus (mg) | Protein (g) |
|---|---|---|---|---|
| **Grains** | | | | |
| White bread | 1 slice | 27 | 24 | 2 |
| Whole wheat bread | 1 slice | 20 | 64 | 3 |
| Long-grain rice | ½ cup | 10 | 81 | 3 |
| Corn tortilla | 1 med | 44 | 79 | 1 |
| **Vegetables** | | | | |
| Artichoke, boiled | 1 med | 135 | 258 | 3 |
| Kale, frozen, boiled | ½ cup | 90 | 18 | 2 |
| Spinach, boiled | ½ cup | 122 | 50 | 3 |
| Turnip greens, boiled | ½ cup | 99 | 21 | 1 |
| **Fruits** | | | | |
| Orange juice, calcium fortified | ¾ cup | 200 | 25 | 0 |
| Avocado, raw | 1 med | 13 | 45 | 2 |
| **Milk** | | | | |
| Skim | 1 cup | 302 | 247 | 8 |
| 2% | 1 cup | 297 | 232 | 8 |
| Chocolate milk (with 1% milk) | 1 cup | 287 | 256 | 8 |
| Low-fat fruit-flavored yogurt | 1 cup | 314 | 247 | 8 |
| Cheddar cheese | 1 oz | 214 | 145 | 7 |
| **Meat and Beans** | | | | |
| Ground beef, broiled | 3½ oz | 12 | 191 | 27 |
| Ham, cured, roasted | 3½ oz | 6 | 224 | 19 |
| Chicken breast, roasted | ½ | 13 | 196 | 27 |
| Salmon, Chinook | 3 oz | 24 | 316 | 22 |
| Refried beans, canned | ½ cup | 45 | 109 | 7 |
| Great northern beans, canned | ½ cup | 70 | 178 | 7 |
| Egg, poached | 1 | 25 | 89 | 6 |
| Almonds, blanched | 1 oz | 73 | 150 | 6 |
| Peanut butter | 2 tbsp | 13 | 101 | 7 |

grains
vegitables
milk
meat and beans
selected foods

## Choice Lists and Examples of Representative Foods

| Choice Lists | Examples of Representative Foods |
|---|---|
| High-protein foods | Beef, fish, eggs, poultry, shellfish |
| High protein and high phosphorus | Cheese, dried peas and beans, milk, yogurt, tofu |
| High protein and high sodium | Canned tuna and salmon; cottage cheese; deli beef or turkey; vegetarian burgers |
| Vegetables | |
| Low potassium | Cabbage, carrots, corn, eggplant, green beans, onions |
| Medium potassium | Asparagus, broccoli, celery, peas, turnips, zucchini |
| High potassium | Avocado, Brussels sprouts, "greens," okra, potatoes, pumpkin, spinach, sweet potatoes, tomatoes, yams |
| Bread, cereal, and grain | Bagel, bread, pita, flour tortilla, low-salt ready-to-eat cereals, pasta, rice, unsalted crackers |
| Bread, cereal, and grain with added salt and phosphorus | Muffins, oatmeal, most ready-to-eat cereals, pancakes, waffles |
| Fruit | |
| Low potassium | Apples, blueberries, grapes, pineapples, watermelon |
| Medium potassium | Cherries, cantaloupe, papaya, prunes, raisins |
| High potassium | Apricots, bananas, nectarines, orange juice, prune juice |
| Fluids | Beverages, ice, soup, gelatin; ice cream and ice milk (each melt to ½ initial volume) |
| Calorie and flavoring | Gumdrops, hard candy, jelly, jelly beans, lifesavers, margarine, mayonnaise, sugar, syrup, vegetable oil |
| Salt | 2 tbsp ketchup, 1/8 dill pickle, 1/8 tsp salt, ¾ tsp soy sauce, 3 tbsp taco sauce |

choice list
high protien foods vegetablesfruit fluids salt

# ACUTE RENAL FAILURE (ARF)

- The sudden loss of renal function characterized by:
  - acute increase in serum creatinine
  - decrease in urine output

- It can develop over a period of hours or days, and the impairment can range from mild to severe

# ACUTE RENAL FAILURE (ARF)

- causes of ARF :
  - Severe infection
  - Trauma
  - Medications
  - Obstruction

- In most cases, patients who recover from the underlying illness are able to recover from ARF

# Nutrition Therapy

- It has **NOT** been proven that nutrition therapy for ARF promotes recovery of kidney function or improves survival

- But it is a way of supporting the patient until the underlying illness is controlled

## Nutrition Guidelines for Acute Renal Failure

| Nutrient | Recommendations | Factors that Impact Actual Allowance |
|---|---|---|
| Protein | 0.6–2.0 g/kg | Degree of catabolism<br>Renal function<br>Use of dialysis |
| Calories | 35–50 cal/kg | Degree of stress<br>Nutritional status |
| Sodium | 1.1–3.3 g/day | Serum sodium levels<br>Blood pressure<br>Edema<br>Urinary losses (in diuretic phase)<br>Use of dialysis |
| Potassium | 2.0–3.0 g/day | Serum potassium levels<br>Urinary losses (in diuretic phase) |
| Phosphorus | Individualized | Serum phosphorus levels |
| Calcium | Individualized | Serum calcium levels |
| Fluid | 500 mL + urine output | Urine output<br>Type of dialysis, if any |
| Vitamins and minerals | DRI amounts | Level of catabolism |

acute renal failure protien
acute renal failure calories
acute renal failur sodium
acute renal failure potassium

# KIDNEY STONES

- Form when insoluble crystals precipitate out of urine

- Composition of the stones :
  1. calcium oxalate (75% of kidney stones)
  2. calcium phosphate, uric acid, or magnesium ammonium phosphate (the remaining)

# Kidney Stones : Risk Factors

- Dehydration
- low urine volume
- urinary tract obstruction
- Gout
- Chronic inflammation of the bowel
- Intestinal bypass or ostomy surgery

# Kidney Stones : Risk Factors

- Nutritionally :
  - inadequate fluid intake
  - Excessive intakes of oxalate, calcium, protein, and sodium

- may increase the risk of calcium oxalate stones in susceptible people.

# Fluid Intake

- *Fluid.*
  - A low fluid intake concentrates the urine, increasing the likelihood of chemicals precipitating out to form kidney stones—regardless of the composition of the stone.

- An adequate fluid intake helps keep urine dilute.

# Oxalate

- *Oxalate.*
  - Normally only 6% to 14% of **oxalate** consumed is absorbed

- Hyperoxaluria is a primary risk factor for the formation of calcium oxalate kidney stones
  - can be caused by genetic disorders, altered bowel function, or a high oxalate intake

- People who have **hyperoxaluria**, known as “super absorbers,” can absorb 50% more oxalate than nonstone formers

# Oxalate

- People who form calcium oxalate stones are advised to limit their intake of oxalate, which is found primarily in plants

- Because **megadoses** of vitamin C increase both oxalate absorption and oxalate synthesis in people prone to calcium oxalate stones, daily doses should be limited to less than 2000 mg/day

## FOODS HIGH IN OXALATE

- Nuts: peanuts, almonds, pecans, cashews, walnuts
- Nut butters
- Tea
- Instant coffee (more than 8 oz/day)
- Rhubarb
- Beets
- Beans: green, wax, baked, and dried, such as kidney beans, garbanzo beans, pinto beans
- Berries: blackberries, raspberries, strawberries, gooseberries
- Chocolate
- Concord grapes
- Dark leafy greens
- Oranges
- Tofu
- Sweet potatoes
- Draft beer

# Oxalate and Ca intake

- Dietary calcium favorably binds with dietary oxalate in the intestines, forming an insoluble compound that the body cannot absorb

- When calcium intake is low, more oxalate is available for absorption and the risk of stone formation increases.
- A normal calcium intake consumed throughout the day is recommended to prevent stone formation.

- *Protein.* High intakes of animal protein increase urinary excretion of calcium, oxalate, and uric acid, and reduce urinary pH .
  - Protein intake in excess of the RDA is not recommended for people with a history of calcium oxalate kidney stones.

- *Sodium.* A high sodium intake promotes urinary calcium excretion by decreasing calcium reabsorption by the kidney .
  - Patients with hypercalciuria should limit their intake of sodium.