Medical Nutrition Therapy for Different Types of Renal Disease

Carla Vartanian
What are the Functions of the Kidneys?

A- Excretory.
B- Acid-base Balance.
C- Endocrine.
D- Fluid & Electrolyte Balance.
The Most Common Causes of Kidney Diseases

◆ **Diabetic Nephropathy**: Damage to the nephrons in the kidneys from unused sugar in the blood, usually due to Diabetes.

◆ **High Blood Pressure**: Can damage the small blood vessels in the kidneys causing filtration problems.

◆ **Polycystic Kidney Disease**: A hereditary kidney disease in which many cysts grow in the kidneys and may lead to kidney failure.
Different Types of Kidney Diseases

- **Glomerular Diseases:**
  - Nephrotic syndrome.
  - Nephritic syndrome.

- **Tubular Defects:**
  Acute renal failure.

- **Other:**
  - Chronic Renal Failure/ End-stage Renal Disease
  - Kidney stones.
The Most Common Kidney Diseases

◆ **Acute Renal Failure**: Sudden kidney failure caused by blood loss, drugs or poisons.

◆ **Chronic Renal Failure**: Gradual loss of kidney function.

◆ **End-Stage Renal Disease**: The condition of total or nearly total and permanent kidney failure.
Screening

The National Kidney Foundation, US-2016: Testing for all patients with diabetes, hypertension, a family history of kidney disease, age >60 years, and ethnic minorities because these are the most prominent risk factors for chronic kidney disease.

*For patients who are at increased risk for CKD, it is recommended that the minimal screening for kidney damage include assessment of GFR and proteinuria.


HOWEVER

• The National Kidney Foundation and the European Society of Cardiology/European Society of Hypertension: Screening for Microalbuminuria.

"Microalbuminuria has now been considered an essential component in the assessment of organ damage because its detection is easy and relatively inexpensive."
Screening

**The American Diabetic Association:**
- All diabetic patients have an annual screen for microalbuminuria.
- Microalbuminuria is considered positive when the level is $>30$ mg/g; however, there are gender-specific values that have not entered into routine use at this point ($>17$ mg/g in men and $>25$ mg/g in women).
- Regardless of the cause of kidney disease, tight glycemic control should be achieved for all diabetic patients.
- HbA1c $<7.0$ for all diabetics, regardless of whether kidney disease is present.
- Metformin is contraindicated with creatinine $>1.5$ in men and $1.4$ in women because of the concern about lactic acidosis.
- Currently, there is agreement among the recommendations for assessment of renal function with screening chemistry and calculated GFR.

*Diabetes Care 2014;37:Supplement 1*
Nephritic Syndrome

- Acute glomerulonephritis.
- Sudden onset, often after streptococcus infections.
- Symptoms include hematuria, hypertension.
- Usually resolves on their own or advance to nephrotic syndrome or ESRD.
Medical Nutrition Therapy for Nephritic Syndrome

- Diet to treat underlying disease.
- Restrict diet if necessary to control symptoms.
- Protein restricted in uremia.
- Sodium restriction in hypertension.
- Potassium restriction in hyperkalemia.
Nephrotic Syndrome

- Alterations of the glomerular basement membrane allows persistent loss of large amounts of protein in the urine.

- Associated with diabetes, glomerulonephritis, amyloidosis, lupus.

- High risk for cardiovascular disease.

- Hypercoagulability.

- Abnormal bone metabolism.
  - Albuminuria >3 g/day urinary albumin losses, with proportionally lesser amounts for children.
    - Hypoalbuminemia
    - Hypertension
    - Hyperlipidemia
    - Edema
Medical Nutrition Therapy for Nephrotic Syndrome

- Protein: 0.8-1 g/kg IBW (80% HBV)
- Sodium based on fluid status.
- Potassium and other minerals (Ca, P) monitored and individualized.
- Fluids unrestricted.
- Diet therapy probably not effective for hyperlipidemia; may require medication.
# Kidney Failure

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Acute renal failure</strong> (ARF)</td>
<td>A sudden loss of kidney function caused by an illness, an injury, or a toxin that stresses the kidneys (kidney function may recover)</td>
</tr>
<tr>
<td><strong>Chronic kidney disease</strong> (CKD)</td>
<td>A long and usually slow process where the kidneys lose their ability to function</td>
</tr>
<tr>
<td><strong>End-stage renal disease</strong> (ESRD)</td>
<td>When the kidneys have completely and permanently shut down</td>
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</table>
Goals of Nutrition Therapy in Renal Failure

- Ensuring adequate nourishment, energy, vitamins & minerals.
- Minimizing the burden of uremia, by optimizing & limiting the protein intake.
- Alleviating the fluid overload and the electrolyte/acid base balance by controlling the intake of Na, K and fluids.
- Preventing and retarding the metabolic derangements of renal osteodystrophy by maintaining Ca, P and Vitamin D homeostasis.
- Delaying the progression of renal failure. (This goal specifically applies to patients in the pre-dialysis phase, who have a diminishing GFR between 25ml/mn and 5-10ml/mn and are being conservatively managed).
Medical Nutrition Therapy for Acute Renal Failure

- **Energy:** BEE X 1.2-1.3 or 25-35 kcal/kg

- **Protein:** 0.8-1.2 g/kg noncatabolic, without dialysis; 1.2-1.5 g/kg catabolic and/or initiation of dialysis.

- **Fluid:** 24 hour urine output + 500 ml (750-1500 ml).

- **Sodium:** 2.0-3.0 grams.

- **Potassium:** 2.0-3.0 grams.

- **Phosphorus:** 8-15 mg/kg; may need binders; needs may increase with dialysis, return of kidney function, anabolism.
Chronic Kidney Disease

Causes of Chronic Kidney Disease

- Type 2 diabetes: 42%
- High blood pressure: 3%
- Glomerular diseases: 3%
- Miscellaneous: 3%
- Unknown: 3%
- Type 1 diabetes: 3%
- Cystic/Hereditary: 3%
- Nephritis: 3%
- Tumors: 3%
CKD Risk Factors*

**Modifiable**
- Diabetes
- Hypertension
- History of AKI
- Frequent NSAID use

**Non-Modifiable**
- Family history of kidney disease, diabetes, or hypertension
- Age 60 or older (GFR declines normally with age)
- Race/U.S. ethnic minority status

*Partial list
AKI: acute kidney injury
Causes of CKD in people with and without diabetes

- Diabetic Nephropathy
- Hypertension
- Renovascular
- Other Kidney Diseases

People with Diabetes
People without Diabetes
Stages of Chronic Kidney Disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Below normal to mild loss of kidney function</td>
</tr>
<tr>
<td>2</td>
<td>Mild to moderate loss of kidney function</td>
</tr>
<tr>
<td>3</td>
<td>Moderate to severe loss of kidney function</td>
</tr>
<tr>
<td>4</td>
<td>Severe loss of kidney function</td>
</tr>
<tr>
<td>5</td>
<td>Kidney failure — Dialysis</td>
</tr>
</tbody>
</table>

- Often No Symptoms
- High B/P, Protein in Urine
- Anemia, Early Bone Disease
- Fatigue, Swelling, Nausea, Vomiting, etc.
Nomenclature of Malnutrition / Wasting Syndromes in Chronic Kidney Disease

- Various different terms and definitions have been used by different authors for conditions associated with loss of muscle and fat tissue, malnutrition, and inflammation in patients with CKD:
  
  *Uremic malnutrition, uremic (renal) cachexia, protein-energy malnutrition, malnutrition-inflammation atherosclerosis syndrome or malnutrition-inflammation complex (or cachexia) syndrome.*

- To avoid confusion the International Society of Renal Nutrition and Metabolism (ISRNM)'s expert panel has recommended the term:

  "**Protein-Energy Wasting**" (PEW):

  “A state of decreased body stores of protein and energy fuels, often associated with diminished functional capacity related to metabolic stresses”

*International Society of Renal Nutrition and Metabolism, 2016*
# Stages of CKD Nutrient Recommendations

<table>
<thead>
<tr>
<th>Stage</th>
<th>Protein g/kg</th>
<th>Kcal/g/day</th>
<th>Na/g/day</th>
<th>K+</th>
<th>Phosphorus mg/day</th>
<th>Calcium g/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.75</td>
<td>Based on EE</td>
<td>1-4 g to NAS</td>
<td>No restriction Unless high</td>
<td>Monitor and restrict if nec</td>
<td>1.2-1.5</td>
</tr>
<tr>
<td>2</td>
<td>0.75</td>
<td>Based on EE</td>
<td>1-4 g to NAS</td>
<td>No restriction Unless high</td>
<td>Monitor and restrict if nec</td>
<td>1.2-1.5</td>
</tr>
<tr>
<td>3</td>
<td>0.75</td>
<td>Based on EE</td>
<td>1-4 g to NAS</td>
<td>No restriction Unless high</td>
<td>800-1000 mg/day</td>
<td>1.2-1.5</td>
</tr>
<tr>
<td>4</td>
<td>0.6</td>
<td>30-35 kcal/kg</td>
<td>1-4 g to NAS</td>
<td>No restriction Unless high</td>
<td>800-1000 mg/day</td>
<td>&lt;2000 mg/day</td>
</tr>
<tr>
<td>5</td>
<td>0.6-0.75</td>
<td>30-35 kcal/kg</td>
<td>1-4 g to NAS</td>
<td>No restriction Unless high</td>
<td>800-1000 mg/day</td>
<td>&lt;2000 mg/day</td>
</tr>
</tbody>
</table>
# Renal Exchanges for Meal Planning

<table>
<thead>
<tr>
<th>Food Groups</th>
<th>Kcal</th>
<th>CHO g.</th>
<th>PRO g.</th>
<th>FAT g.</th>
<th>Na mg.</th>
<th>K+ mg.</th>
<th>PO4 mg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk ( ½ c.)</td>
<td>85</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>80</td>
<td>185</td>
<td>110</td>
</tr>
<tr>
<td>Meat</td>
<td>65</td>
<td>0</td>
<td>7</td>
<td>4</td>
<td>25</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>Starch</td>
<td>80</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>80</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Vegetable</td>
<td>25</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>150</td>
<td>20</td>
</tr>
<tr>
<td>Fruit</td>
<td>60</td>
<td>15</td>
<td>0.5</td>
<td>0</td>
<td>5</td>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>Fat (1TB.)</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>150</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Calorie Boosters</td>
<td>60</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Beverages: Coffee (1c.), tea (1 bag), wine (4 oz.), beer (12 oz.)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>
Calorie Boosters
60 kcals, 15 g CHO, 15 mg Na+, 20 mg K+, 5 mg PO4

- Hard candy: 4 pieces
- Jam or jelly: 2 T
- Jelly beans: 15
- Honey: 2 T
- Sugar brown or white: 2 T
- Marshmallows: 5 large
- Fruit snacks and candies: 1 oz
Anthropometric Measurements in CKD

✓ % usual body weight (%UBW).
✓ % standard body weight (%SBW).
✓ Height.
✓ Skeletal frame size.
✓ BMI.
✓ Skin-fold thickness.
✓ Mid-arm muscle area, circumference, or diameter.
Lipids

- Cardiovascular disease is the most common cause of death in people with CKD.
- Patients with CKD frequently have multiple lipid abnormalities; but, LDL should be the primary target, with attention paid to the non–HDL levels if the triglycerides are elevated to >200.

The NKF: considers chronic kidney disease to be a coronary heart disease equivalent, placing all chronic kidney disease patients in the high-risk group as defined in the ATP III guidelines.

HOWEVER

The NCEP (ATP III) does not include chronic kidney disease in its calculation of hyperlipidemia goals.

- Given this information, it is prudent to have LDL goal of >100 mg/dL for all patients with CKD and an optional goal of <70 mg/dL, depending on the patient's additional risk factors or known cardiovascular disease status.

- Hemodialysis Patients: Often have normal LDL, TC, ↑ triglycerides, ↓ HDL
- Pre-Dialysis Patients: Have ↑ LDL/TC + ↑ TG
Skeletal Effects of Chronic Renal Failure

- Hyperphosphatemia.
- Hypocalcemia.
- Hyperparathyroidism.
- Low bone mass and density.
- Osteitis fibrosa cystica—hyperplastic demineralized bone.
ESRD: Medical Management

- Dialysis.
- Immunosuppressant drugs.
- Kidney transplant.
- Psychological support.
Hemodialysis

High mortality rates during the first year of hemodialysis are a big challenge

Reference: USRDS Annual Data Report (NIDDK, 2011)
Interdialytic Weight Gain

• Patients on dialysis gain several kg of fluid between treatments.

• Weight gain >5%, may reflect excessive fluid intake, leading to hypertension, edema, ascites, pleural effusion.
Hemodialysis: Medical Nutrition Therapy

- Prevent deficiencies, renal osteodistrophy and control edema and serum electrolytes.
- Provide an attractive and palatable diet.
- HD patients at risk for lipid disorders.
  - Recommended fat intake < 30% of calories and saturated fat < 10%; cholesterol < 300 mg/day.
- Optimum fiber intake 20-25 g/day.
- 10-12 g free amino acids lost per treatment during dialysis.
  - Greater amino acid losses with glucose-free dialysate and high flux dialyzers.
- 1.2 g protein/kg standard body weight (SBW) with 50% high biological value (meat, poultry, fish, eggs, soy, dairy).
- Most HD patients take in less than 1 g/day.
- Renal patients should use calcitriol supplements under the supervision of a physician.
- **Typical diet order:**
  - 2000 calorie, 80 g protein, 2 g Na+, 3 g K+, low phosphorus, 1500 cc fluid restriction.
Nutrition in Peritoneal Dialysis: Weight gain, Hypertriglyceridemia, Hyperglycemia

- Diet liberal, independence.
  - Exercise can be increased as allowed by MD.
  - Na and fluids should be limited to minimize hypertonic exchanges.
  - Energy intake should be modified to facilitate weight loss.
  - Sugars and fats should be modified, especially saturated fats.
  - Patient education regarding protein goals and ways to meet them:
    - Eat protein foods first and limit fluids at mealtime.
    - Frequent smaller portions of protein and easy to eat proteins such as egg white, cottage cheese…
Nutritional Parameter Requirements for Varying Levels of Kidney Disease
( American Dietetic Association Guidelines)

<table>
<thead>
<tr>
<th>Nutritional Parameter</th>
<th>Stages 1-4 CKD</th>
<th>Stage-5 (Hemodialysis)</th>
<th>Stage-5 (Peritoneal Dialysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories (kcal/kg/d)</td>
<td>35 (&lt; 60 yrs)</td>
<td>35 (&lt; 60 yrs)</td>
<td>35 (&lt; 60 yrs)</td>
</tr>
<tr>
<td>Protein (g/kg/day)</td>
<td>0.6-0.75</td>
<td>1.2</td>
<td>1.2-1.3</td>
</tr>
<tr>
<td>Fat (% total kcal)</td>
<td>For patients at risk for CVD, &lt;10% saturated fat, 250-300 mg cholesterol/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium (mg/day)</td>
<td>2000</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>Potassium (mg/day)</td>
<td>Match to lab values</td>
<td>2000-3000</td>
<td>3000-4000</td>
</tr>
<tr>
<td>Calcium (mg/day)</td>
<td>1200</td>
<td>≤2000 from diet and meds</td>
<td>≤2000 from diet and meds</td>
</tr>
<tr>
<td>Phosphorus (mg/day)</td>
<td>Match to lab values</td>
<td>800-1000</td>
<td>800-1000</td>
</tr>
<tr>
<td>Fluid (mL/day)</td>
<td>Unrestricted w/normal urine output</td>
<td>1000 + urine</td>
<td>Monitor: 1500-2000</td>
</tr>
</tbody>
</table>
Kidney Transplant: Nutritional Therapy

Post-transplant Management:

*Diet while on high-dose steroids:
- 1.3 to 2 g/kg BW protein.
- 30 to 35 kcal/kg BW energy.
- 80 to 100 mEq Na.

*Diet after steroids:
- 1 g/kg BW protein.
- Kcal to achieve IBW.
- Individualize Na level.
Kidney Stones: Nutritional Therapy

- Urinated more than 2L per day.
- Consume enough dietary calcium to meet the RDA.
- Avoid dietary oxalates (for calcium oxalate stone formers).
- Limit Sodium to 2000mg/day.
- Lose weight if overweight.
- Limit protein to 12 ounces/day:
  *Excessive protein intake increases the excretion of potentially lithogenic substances such as calcium and uric acid.

- Study (Reddy et al, 2002): Consumption of high protein diet for 6 weeks was associated with aciduria and urinary calcium and claimed that this increased risk of stone formation in 10 healthy subjects. (*Am J Kidney Dis. 2002 Aug;40(2):265-74.*)
Study: ESRD Linked to Diet Soda Consumption

**Introduction:** Diet soda consumption may be associated with kidney disease due to phosphorus content, by increasing dietary acid load, or as a proxy for poor diet quality. However, less is known about the relationship between diet soda consumption and ESR risk in the general population.

**Intervention:** A prospective analysis of time-varying diet soda consumption and incident ESRD in the population-based Atherosclerosis Risk in Communities study (N=15,369) using Cox regression.
- Diet soda consumption, assessed by food frequency questionnaires for 15,368 black and white participants (aged 45 to 64) during 1987-1989 and 1993-1995.
- During 23 years of follow up through 2012, ESRD developed in 357 participants.

**Results:**
ESRD risk was greater by 8%, 33%, and 83%, for those who consumed 1–4, 5–7, and more than 7 glasses of diet soft drinks each week, respectively, compared with those who consumed less.

**Conclusion:** Diet soda consumption was associated with ESRD risk and may be an important target for dietary interventions aimed at slowing kidney disease progression.

_Circulation, 2016;133:A36_
Figure. Risk of Incident End-Stage Renal Disease According to Frequency of Diet Soda Consumption

- Adjusted Hazard Ratio (95% Confidence Interval)
  - <1 Glass/Month: 1 [Reference]
  - ≥6 Glasses/Week: 1.28 (0.96, 1.70)
  - >6 Glasses/Week: 1.95 (1.43, 2.64)

* Adjusted for total caloric intake, sugar-sweetened beverages, diet quality, age, sex, race-center, estimated glomerular filtration rate, diabetes, hypertension, overweight/obesity status, education level, smoking status, and physical activity
Study: Medical Nutrition Therapy for Chronic Kidney Disease Improves Biomarkers and Slows Time to Dialysis

**Objective:** Investigate whether MNT provided by an RD experienced in CKD slows the progression of disease and improves nutrition-related biomarkers.

**Design:** Retrospective cohort study.

**Subjects:** The investigators examined the medical records of 265 CKD patients treated at a single outpatient clinic in Vermont from 2003-2013. Of these, 147 received MNT from an RD and were compared to a group that did not receive MNT and had started dialysis over a 10-year period.

**Intervention:**
- MNT by a registered dietitian with expertise in CKD.
- Main Outcome Measure
- Average time to dialysis, based on stage of CKD at baseline, was compared between groups.
- In addition, the effect of MNT on the change in biochemical measures for estimated GFR, BUN, albumin, CKD Mineral and Bone Disorder markers (P, Ca, and intact PTH) at baseline and at follow-up (dialysis initiation or most recent laboratories if dialysis was not started) was assessed.

**Results:**
- MNT group had less of a decline in estimated glomerular filtration rate than the non-MNT group (0.3 vs. 9.9 mL/minute/1.73 m², respectively).
- After adjusting for CKD stage, that difference grew between groups. When adjusted for stage using linear regression, the mean difference was greater. Albumin and markers of CKD-MBD were more likely to be within normal limits in the MNT group.
- In addition, the non-MNT group was 3 times more likely to start dialysis; that rose to nearly 3.5 times for stage 3 and 4 CKD patients not receiving MNT.
- The study did not assess patient survival.
- The researchers also examined patients' nutritional status.
- Study limitations included small numbers of patients and lack of accounting for healthy behaviors and co-existing illnesses besides diabetes.

**Conclusion:**
- People with CKD who received MNT were their nutritional status and delay dialysis initiation, less likely to start dialysis and had improved nutritional biomarkers than participants who did not receive MNT.
- Researchers further discovered that patients who start MNT at an earlier stage of CKD (3 or 4) have slower progression to end-stage renal disease than those who receive it at stage 5.

The Principles of Managed Kidney Care

- Education
- Empowerment
- Encouragement

Shared Decision Making

- Registration
- Recall
- Review

Integration
Information Technology
Information

Choose and prepare foods with less salt (sodium). Use less salt at the table.

Select the right kinds and smaller amounts of protein.

Choose foods that are healthy for your heart, like lean cuts of meat, skinless chicken, fish, fruits, vegetables, and beans.

Read the Nutrition Facts Label, especially for sodium, to help you pick the right foods and drinks.