Nutrition and Chronic Kidney Disease: Designing Diets for a Complex Population

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Honoraria: Genzyme
Introduction

- Nutritional management in renal disease plays a role in all stages of CKD and evolves as the disease changes.
- Diet is complex and at times conflicts with other nutrition recommendations.
- Diet plays a role in preventing progression of CKD as well as preventing and managing complications.
What is the renal diet?

- No standard renal diet
- Requires individual assessment
- Depends on:
  - Stage
  - Modality of RRT
  - Medications
  - Comorbidities (diabetes, celiac, cardiac)
  - Labs
  - Lifestyle
Burden of the Renal Diet

- Patients’ perspective of renal diet:
  - Complex and confusing
  - Isolating
  - Perceived as unhealthy and perhaps causing other problems
  - Conflicting messages

Renal Diet Components

- Sodium
- Protein
- Phosphorus
- Potassium
- Fluid
- Any other therapeutic diet considerations

Goal should be ONE diet!
Sodium

- Guidelines consistent with most other chronic disease guidelines
- Low sodium guidelines do not change as the disease progresses
Sodium

Most people perceive their diet as low in salt as long as they don’t add salt at the table.

Source: Hypertension Canada
Sodium

- Considered the cornerstone of public health initiatives to reduce blood pressure
- Based on Cochrane Review a reduction in average dietary sodium intake by 1800 mg/d (from 3500 mg to 1700 mg in Canada) would result in:
  - 1 million fewer hypertensive Canadians
  - Almost double the BP treatment and control rate
  - Hypertension care cost savings of $430 to 538 million /yr
# Impact of Lifestyle Therapies on Blood Pressure in Hypertensive Adults

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Intervention</th>
<th>SBP/DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce sodium intake</td>
<td>-1800 mg/day sodium Hypertensive</td>
<td>-5.1 / -2.7</td>
</tr>
<tr>
<td>Weight loss</td>
<td>per kg lost</td>
<td>-1.1 / -0.9</td>
</tr>
<tr>
<td>Alcohol intake</td>
<td>-3.6 drinks/day</td>
<td>-3.9 / -2.4</td>
</tr>
<tr>
<td>Aerobic exercise</td>
<td>120-150 min/week</td>
<td>-4.9 / -3.7</td>
</tr>
<tr>
<td>Dietary patterns</td>
<td>DASH diet Hypertensive</td>
<td>-11.4 / -5.5</td>
</tr>
</tbody>
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Padwal R. et al. CMAJ · SEPT. 27, 2005; 173 (7) 749-751
Randomized 412 adults (mixed B.P. status, racial groups, sexes) to:

- Control diet - low in fruit, veg and dairy, fat content typical of US
- DASH diet - high in fruit, veg and low-fat dairy, reduced fat content
- Consume diet for consecutive 30 day periods in random order at each of 3 levels of salt

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Change in mean B.P. vs. control (systolic)</th>
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<tbody>
<tr>
<td></td>
<td>Control diet</td>
</tr>
<tr>
<td>9g/d salt</td>
<td>Control level</td>
</tr>
<tr>
<td>6g/d salt</td>
<td>- 2 mmHg</td>
</tr>
<tr>
<td>3g/d salt</td>
<td>- 7 mmHg</td>
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<tr>
<td></td>
<td>DASH diet</td>
</tr>
<tr>
<td>9g/d salt</td>
<td>- 6 mmHg</td>
</tr>
<tr>
<td>6g/d salt</td>
<td>- 7 mmHg</td>
</tr>
<tr>
<td>3g/d salt</td>
<td>- 9 mmHg</td>
</tr>
</tbody>
</table>

Sacks et al. NEJM 2001; 344:3-10
Sodium

- Across all stages of CKD
- Early in CKD and for prevention—DASH diet
- Hemodialysis—fluid restriction cannot be achieved without limiting sodium
- Dialysis—goal is to achieve euvolemia
  - Volume overload leads to CHF, LVH and HTN
Protein in CKD

- **Stages 3-5**
  - Goal is to slow progression and decrease uremic load
  - Improved proteinuria in nephrotic patients
  - Phosphate control
  - Low protein diet (0.6-0.8g/kg IBW/d) vs very low protein diet (0.3g/kg IBW/d +aa)
Protein in Diabetic Nephropathy

- Modestly slows progression (non-significant)
- Estimated delay to dialysis of 1-2 months
- Small average benefit may conceal larger benefit for some patients

Impact on Practice: Pragmatic to reduce to max of 1g/kg/d or prescribe 0.8g/kg/d where reasonable and in the absence of malnutrition

Outcomes on Very Low Protein Diet

- MDRD 15yr follow-up
- Low protein did not prevent progression but did increase risk of death
- Lack of follow-up after completion of study

Outcomes on Very Low Protein Diet

- No detrimental effect of very low protein diet was observed
- Patients were closely monitored and supported
- Highly motivated patient group

Protein Restriction

Some evidence that a low protein diet may benefit some patients

BUT:

- Need adequate calories
- High biologic value protein
- Treat metabolic acidosis

Robertson LM et al. Cochrane Database of Systematic Reviews 2007, Issue 4
Protein Restriction

- Benefit in preventing progression is modest
- Risk of malnutrition is significant if no adequate follow-up
- Requires motivated patients and adequate support

48% of patients with chronic kidney disease (CKD) are malnourished before starting dialysis therapy

Am J Kidney Dis 2000 (36), 1213-25
Protein in Dialysis

- Hemodialysis – 1 - 1.2g/kg/d
- PD – 1.2-1.3g/kg/d
- Prevalence of malnutrition estimated to be as high as 18-75% of dialysis
- Goal is to prevent malnutrition and replace losses

Kidney Int. 2008 (73), 391-398.
Serum Albumin and Survival on Dialysis

Survival and Protein Intake

Protein in Dialysis

- Patients report aversion to meat and protein foods
- PD patients often complain of fullness
- Fatigued
- Limited financial and social resources
Phosphorus

- Independent risk factor for morbidity and mortality
- Process begins early in CKD before serum phosphorus rises
- Progressive
Mortality increased linearly with an increase in serum phosphate.

Adjusted hazard of mortality with each 0.32 mmol/L increase in serum phosphorus

Phosphorus and Mortality in Dialysis

Relative Risk of Death*

Serum Phosphorous Concentration (mmol/L)

*Multivariable Adjusted

n = 40,538
P < 0.0001

Phosphorus in the Healthy Population

Serum phosphorus levels were shown to have a continuous association with increasing risk for morbidity and mortality within the reference range.

Post Hoc Analysis of ABCD Cohort:

Serum phosphorus was associated with cardiovascular mortality in patients with Type 2 diabetes.

What is FGF-23?

- Protein secreted by osteocytes
- Maintains serum phosphorus in normal range in early CKD
  - Induces phosphaturia
  - Inhibits 1,25 (OH)₂ Vitamin D
- Induced by dietary phosphorus
FGF-23 and Progression of CKD

Early CKD
- Small cohort study (n=227)
- Non-diabetic patients
- FGF-23 independently predicted progression of CKD in mild kidney disease

Advanced CKD
- 1099 patients with advanced CKD
- Retrospective analysis
- Strong association with
  - All-cause mortality
  - Cardiovascular events
  - Dialysis initiation

Phosphorus and Progression of CKD?
Role of FGF-23?

- CKD Dietary Phosphorus
- FGF-23
  - Inhibits 1-α hydroxylase and decreases gut absorption
  - Induces phosphaturia
  - ?role in LVH
- Mortality
  - Cardiovascular events
  - Dialysis
Dietary Phosphorus

Source likely as important as amount

1. Organic phosphorus from meat/poultry/fish
2. Organic phosphorus from vegetarian sources
3. Phosphate additives
   - Extremely well absorbed in the gut
   - Found in cheap/convenience/fast foods
   - Information is not available on nutrition facts tables or in nutrient databases
Dietary Phosphate from Additives

- Estimates range from 10-30% of dietary phosphorus comes from additives.
- Depending on food choices additives may increase dietary phosphorus by as much as 1000mg/d.

Compare this to the CSN and KDOQI recommendations of 800-1000mg/d in CKD.
Phosphorus

- Restrict dietary phosphorus from additives early in CKD
- Consider source and bioavailability
- Avoid processed foods
- As CKD progresses phosphate restriction from all sources (dairy, nuts, whole grains, seeds, legumes)
  - Conflicts with most “healthy diet” advice
Potassium

Not all patients require a restriction

- Stage 5 and hemodialysis
- Need to assess and correct for non-dietary causes of hyperkalemia
  - Insulin omission
  - Meds
  - Constipation (stage 5)
  - Acidosis
Potassium

- Restriction of 40-70mmol/d recommended
- Restricts whole grains, fruits, vegetables, dairy, nuts, seeds, legumes, lentils, salt substitutes

Becomes challenging to achieve adequate micronutrient and fibre intake
Fluids

- Dialysis or CHF
- Fluid recommendations based on:
  - Residual renal function
  - CHF
  - Interdialytic weight gains
  - Body size

In conventional hemodialysis: 1L + urine output
Nutrition and CKD

- Across all stages of CKD, nutrition is associated with outcomes.
- Need to provide patients with one, cohesive diet incorporating all diet recommendations.
- Need to “design” and “redesign” diet as disease and treatments change.
What is the renal diet?

- Sodium 2000mg/d
- Potassium 70mmol/d
- Fluid 1L/d
- Adequate Nutrition
- Phosphorus 1000mg/d
- Protein 80g/d
- Cardiac/Diabetes etc...
What Can I Eat?

- Fresh, unprocessed meats
- Small servings of low potassium fruits and vegetables
- White breads, rice, pasta
- ½ cup dairy/day
Thank you!