Case Study – Case 18: Chronic Kidney Disease (CKD) Treated with Dialysis

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DFM 485: Medical Nutrition Therapy II

Submitted to
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April 14, 2014
1. Describe the physiological functions of the kidneys.

The kidneys’ primary functions are very important in maintaining homeostasis through the regulation of fluid, pH, electrolyte balance, and blood pressure, osmolarity, regulation of the extracellular fluid ions. The kidneys excrete foreign wastes and metabolic end-products such as the urea, uric acid, creatinine and toxins of drugs. Kidneys also produce enzymes, hormones, and controls hydrogen and bicarbonate ions. The blood entering the kidneys are filtered, proteins and minerals are reabsorbed, while metabolic wastes, such as uric acid, creatinine, urea, environmental toxins and drugs are excreted in the urine. The kidneys filter the blood. Glomerular filtration (GF), tubular reabsorption, and tubular secretion are the three primary steps in which kidneys filter blood and maintain proper electrolyte balance. GF removes solutes from the blood. Tubular secretion is the last step of urine formation, where solutes and waste are secreted into the collecting ducts, ultimately flowing to the bladder in the form of urine. Tubular secretion is the last step of urine formation, where solutes and waste are secreted into the collecting ducts, ultimately flowing to the bladder in the form of urine. All the blood in the body passes through the kidneys several times a day. Both kidneys contain an abundance of nephrons, which help filter the blood and consists of a proximal convoluted tubule, Loop of Henle, distal convoluted tubule, and a collecting duct. Healthy kidneys produce red blood cells, hormones, and enzymes. They also play a role in maintenance of bone health. The kidneys can be broken up into three different processes (filter, reabsorb, and secrete). Filtration is the movement of fluid from blood into the lumen of the nephron, which only takes place in the renal corpuscle. A filtrate forms and becomes part of the body’s external environment and mostly likely going to be excreted. Excretion is the removal of urine unless it is reabsorbed into the body. Reabsorption is the process of moving substances in the filtrate from the lumen of the tubule back into the blood flowing through peritubular capillaries. Usually it is the hydrogen ions from carbonic acid are excreted as water, while carbon dioxide is reabsorbed, which plays a role in the control of pH balance. Secretion removes selected molecules from the blood and adds them to the filtrate in the tubule lumen.

2. What disease/conditions can lead to chronic kidney disease (CKD)? Explain the relationship between diabetes and CKD.

Disease and conditions that can lead to CKD include: hypertension, obesity, diabetes, glomerulonephritis, urinary tract infections, kidney stones, cancer, and exposure to drugs can lead to CKD. CKD is kidney damage of glomerular filtration rate. When high levels of blood glucose from uncontrolled diabetes can change the nephrons and how they filter waste from blood into urine for excretion. These changes can be thickening of the glomeruli, which leads to larger amounts of protein concentration from the blood to the urine that is excreted and filtration rate decreases.

3. Outline the stages of CKD, including the distinguishing signs and symptoms.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>GFR (mL/min/1.73m²)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>At increased risk</td>
<td>≥60 (w/ CKD risk factors)</td>
<td>Screening CKD risk reduction</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Kidney damage w/ normal increased GFR</td>
<td>≥90</td>
<td>Diagnosis and treatment. Treatment of comorbid conditions. Slowing progression CVD risk reduction</td>
</tr>
<tr>
<td>2</td>
<td>Kidney damage with mild decrease in GFR</td>
<td>60 - 80</td>
<td>Estimating progression</td>
</tr>
</tbody>
</table>
4. From your reading of Mrs. Joaquin’s history and physical, what signs and symptoms did she have that correlate with her chronic kidney disease?

The client was diagnosed with type 2 DM at age 13, has high blood pressure, kidney and urinary problems. Her glomerular filtration rate (GFR) value has been declining with increasing concentrations of creatine and urea. The clinical definition of CKD includes a long-term reduction in GFR, decreased creatinine clearance, and a corresponding increase in serum creatinine concentration (Nelms, 2011, p.524). CKD is defined as having a GFR of less than 60 mL/min/1.73 m² for 3 months or longer and/or albuminuria of more than 30 mg of urinary albumin per gram of urinary creatinine (Nelms, 2011, p.526). She also has elevated phosphate, normochromic, and normocytic anemia. The normochromic normocytic anaemia mainly develops from decreased renal synthesis of erythropoietin. The anaemia becomes more severe as the GFR decreases. She has shown muscle weakness and edema in the knees. Her yellow-brownish discolored skin is most likely a result of her kidneys inability to filter the waste productions within the body.

The patient's history:
- Diagnosed with type 2 DM at 13 years old.
- Non-compliant with prescribed treatment for diagnosed type 2 DM.
- Family history of type 2 DM from her parents
- GFR Declining over yrs
- Increasing creatine and urea concentrations
- Elevated serum phosphate, normochromic, normocytic anemia
- Overweight Native American
- Involuntary weight gain in past 2 weeks, inability to urinate
- Diagnosed with stage 3 CKD 2 years ago, acute symptoms have developed over the past 2 weeks

Physical exam:
- 3+ pitting edema to knees
- High Blood Pressure
- Muscle weakness

5. What are the treatment options for stage 5 CKD? Explain the differences between hemodialysis and peritoneal dialysis.

There are three options for treatment of stage 5 CKD: hemodialysis, peritoneal dialysis, and kidney transplantation. When renal replacement becomes a factor, nutrition therapy is important. A renal transplant is a surgical kidney transplantation from a matched donor or related donor. Two types of renal replacement therapy are used for patients with CKD Stage 5 if they do not decide or can receive a transplant. The most common therapy method is hemodialysis (HD), but peritoneal dialysis (PD) is also used. The type of dialysis the patient receives is chosen based on several factors, including underlying kidney disease and other factors such as cardiovascular disease, age, family support, and proximity to a dialysis center (Nelms, 2011, p.527)
Hemodialysis – Wastes or uremic toxins are filtered from the blood by semipermeable membrane and removed by the dialysis fluid. Patients need to first undergo a procedure that allows continual access to the bloodstream. The preferred permanent access site is an arteriovenous fistula (AVF), created surgically by fashioning in the forearm a subcutaneous joining of the radial artery and the cephalic vein. If the patient’s veins are not adequate for this procedure, an arteriovenous graft (AVG) can be created. Blood travels through a needle placed into the arterial side of the graft. The needle is attached to tubing that leads to the hollow fibers of the dialyzer, or between the sheets of membranes in the parallel plate design. While blood passes through the dialyzer, dialysate simultaneously passes around the artificial membrane. Electrolyte content of the dialysate is similar to that of normal plasma, this results in the removal of waste products and excess electrolytes from the blood to the dialysate via diffusion, ultrafiltration, and osmosis. This is usually done three times a week for an average of 3-4 hours per treatment. Most hemodialysis treatments are done at a dialysis center, home treatments can be an option for some patients.

Peritoneal dialysis - The peritoneal cavity serves as the reservoir for dialysis and peritoneum acts as the semipermeable membrane across which excess body fluid and solutes are removed. The process uses the abdomen as a membrane to cross which fluids and dissolved substances are exchanged from the blood. To access to the patient’s blood supply is gained via a catheter of silicone rubber or polyurethane, placed surgically into the peritoneal cavity. There are two main types of peritoneal dialysis (PD): continuous ambulatory peritoneal dialysis (CAPD) and continuous cycling peritoneal dialysis (CCPD).

6. Explain the reasons for the following components of Mrs. Joaquin’s MNT:

<table>
<thead>
<tr>
<th>Nutrition Therapy</th>
<th>Rationale</th>
</tr>
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<tbody>
<tr>
<td>32kcal/kg</td>
<td>Adequate energy intake to prevent catabolism and achieve optimal nutritional status. Sufficient kcal from carbohydrate and fat may help prevent muscle and visceral protein from being utilized as energy.</td>
</tr>
<tr>
<td>1.2g protein/kg</td>
<td>To ensure intake of essential amino acids in order to maintain neutral or positive nitrogen balance and lead to improvement or maintenance of visceral protein stores (Nelms, 2011, p.536)</td>
</tr>
<tr>
<td>2g K</td>
<td>Limiting potassium intake due to the increased risk for hyperkalemia</td>
</tr>
<tr>
<td>1g phosphorus</td>
<td>Restrictions in phos levels are related to diminished functions of the kidneys to remove the excess phos from body causing hyperphosphatemia, overtime can cause pain and other health issues due to the hardening of the tissues.</td>
</tr>
<tr>
<td>2g Na</td>
<td>Na+ restriction is important for the control of fluid intake, fluid retention and control of high blood pressure.</td>
</tr>
<tr>
<td>1000mL fluid + urine output</td>
<td>Fluid restriction is tight when kidney function fails. Edema is common and leads to increased blood pressure, wt gain and congestive heart failure. To control fluid balance due to many patients being oliguric during first 12 months of hemodialysis tx.</td>
</tr>
</tbody>
</table>
7. Calculate and interpret Mrs. Joaquin’s BMI. How does edema affect your interpretation?

Mrs. Joaquin’s BMI is 33.2, which is considered obese. Edema is the fluid retention that accumulates around the interstitial spaces that surround the cells. Since Mrs. Joaquin has edema in the extremities of her body including her face and eyes, her weight may be inflated thus her BMI is probably over estimated because BMI does not take into consideration of the edema.

8. What is edema-free weight? Calculate Mrs. Joaquin’s edema-free weight.

\[ 73.3 \text{kg} \times 2.2 \text{kg/lb} = 161.3 \text{ lbs.} \]

Edema free BMI = 31.6.

\[
[0.25 (161.26 \text{lbs edema free body weight} - 100 \text{lbs ideal body weight}) + 100 \text{lbs IBW}] = 115.32 \text{lbs} = 52.4 \text{kg}
\]

10. Calculate what Mrs. Joaquin’s energy needs will be once she begins hemodialysis.

Mrs. Joaquin’s energy needs will be estimated about 1835 kcal per day once she begins hemodialysis. (35 kcal/kg) = (35kcal x 52.4 kg) = 1835 kcal

11. What will Mrs. Joaquin’s protein requirements be when she begins hemodialysis? What standard guidelines have you used to make these recommendations?

Mrs. Joaquin’s protein requirements will be estimated about 63 grams of protein per day when she begins hemodialysis. The NKF K/DOQI guidelines on nutrition recommend 1.2 grams of protein/kg body weight for hemo dialysis patients with at least 50% of the proteins being of high biological value (Nelms, 2011, p.536).

\[ 1.2 \text{g x 52.5kg body weight} = 63 \text{g/day of protein each day}. \]

12. What are the considerations for differences in protein requirements among predialysis, hemodialysis, and peritoneal dialysis patients?

There is no difference in the protein needs for hemodialysis and peritoneal dialysis patients. Peritonitis can increase the dialysate protein losses by 50% - 100%. The protein needs for someone who has not begun dialysis is much lower. The protein recommendations for a patient with CKD predialysis is lower because low-protein diets can help slow progression of renal disease and delay needs for renal replacement. As the patient’s kidney deteriorates or diminishes in it’s functioning ability, dietary restrictions are implemented to help compensate for it.

13. Mrs. Joaquin has a PO4 restriction. Why? What foods have the highest levels of phosphorus?

High levels of phosphorus in the blood can occur in stage 5 CKD. Phosphorus can build up in the blood and make CKD worse. Mrs. Joaquin is PO4 restricted to prevent hyperphosphatemia. Her serum phosphate levels are very high (9.5 which is higher than the normal range of 2.3-4.7). Due to decreased renal function, phosphate fails to be excreted properly, resulting in hyperphosphatemia. Hyperphosphatemia may be present when GFR falls in-between 20-30 ml/min/1.73m² (Nelms, 2011, p. 541). Hyperphosphatemia can decrease GFR and calcium levels. Foods high in phosphorous include: cheese, beans, bran cereals, oysters, sardines, colas, and organ meats.
14. Mrs. Joaquin tells you that one of her friends can drink only certain amounts of liquids and wants to know if that is the case for her. What foods are considered to be fluid? What recommendations can you make for Mrs. Joaquin? If a patient must follow a fluid restriction, what can be done to help reduce his or her thirst?

Yes, Mrs. Joaquin should watch her fluid intake amount. It is important for those with later stages of CKD to limit fluid intake because the impaired kidney will be less able to remove the fluid, which may lead to complications. Fluid allowances and restrictions are individualized. Depending on what a person’s residual urine output and dialysis modality is, fluid allowance will vary. Other considerations that would be taken into account would be blood pressure control, interdialytic weight gains in HD patients, edema, and congestive heart failure. Recommendation for the patient would be to stay with her 2g/day sodium restriction, with a fluid allowance of no more than 1000 mL or 1 L per day. This fluid allowance would include beverages, as well as foods liquid at room temperature.

Foods that are considered liquids are soups, ice creams, yogurt, custards, gelatin, and popsicles. Recommendations are to limit the sodium intake and to drink from small cups. For dry mouth use sugar free candy to moisten the mouth or use ice cubes instead of water, sugar free quenching gums. Sodium allowances of patients are individualized. If urine output is greater than 1 liter per day, sodium and fluid allowance can be increased to about 2-4 grams sodium per day and 2 liters of fluid per day. Fluid gains that are higher than recommended can lead to sudden changes in blood volume and hypotension during the hemodialysis treatment.

16. Evaluate Mrs. Joaquin’s chemistry report. What labs support the diagnosis of stage 5 CKD?

Stage 5 CKD is very severely reduced kidney function (endstage or ESRF/ESRD)

- Elevated serum creatinine (12.0 vs. ref range of 0.6-1.2) measures the amount of creatinine in your urine and blood, which determines how well the kidneys are filtering creatinine. Significance to high creatinine is associated with muscle damage, catabolism, MI, muscle dystrophy, ARF/CKD, excessive protein intake, inadequate dialysis or transplant rejection (Nelms, 2011, p. 532).

- Increased BUN (69 vs. ref range of 8-18) High blood urea nitrogen indicates insufficient filtration in the kidneys. The BUN is to detect elevated waste levels in the bloodstream, which is an early sign of decreased kidney function.

- Decreased Na+ (130 vs. ref range of 136-145) Low sodium reflects losses in urine or fluid retention. It can be caused by a number of factors including nephritis, diabetic acidosis, and hyperproteinaemia, overhydration, hyperglycemia (Nelms, 2011, p. 534).

- Increased Potassium- K (5.8 vs. ref range of 3.5-5.5) High serum potassium indicates compromised filtration in the kidneys. Abnormal significance of high K is associated with tissue distruption, shock, acidosis, dehydration, hyperglycemia diuretics, excessive oral intake, inadequate dialysis, and inappropriate dialysate K+ (Nelms, 2011, p. 533).

- Increase in Phosphorus-P (9.5 vs. ref range of 2.3-4.7) Healthy kidneys get rid of the extra amounts not needed in the body, but unhealthy kidneys cannot remove phosphorus from the blood & get rid of the excess in urine, high levels of phosphorus (hyperphosphataemia) is a problem in stage 5. High levels of phosphorus in the blood can cause issues such as; low blood Ca, which causes calcium to be taken from the bones, Oral phosphate binders will often be necessary to prevent GI absorption of dietary P. Abnormal significance to high P is osteodystrophy, vit D intoxication, excessive intake, inadequate P binder (Nelms, 2011, p. 533).
• Decrease in Ca (8.2 vs. ref range of 9-11) low serum Ca are associated with CKD due to alterations in vitamin D metabolism (Insufficient active vitamin D prevents calcium reabsorption in the intestines), increased P, and decreased uptake of Ca the in gut. Foods with Ca are restricted because they often have high P dosages too (Nelms, 2011, p. 541). The abnormal significance of low Ca is associated with; insufficient vit D, during bone building, malabsorption, postparathyroidectomy, hypoparathyroidism with low albumin (lack of carrier) (Nelms, 2011, p. 532).

• Increase in Cholesterol (220 vs. ref range of 120-199) Inflammation of the glomerulus can cause altered lipid metabolism, causing high levels of cholesterol and TG. The abnormal significance of high cholesterol is a high cholesterol/saturated fat diet, disorder, lipid metabolism, nephrotic syndrome, and glucocorticoid use (Nelms, 2011, p. 532).

• Increased LDL (<130 vs. ref range of 135)

• Decrease in HDL (50 vs. ref range of >55F)

• Increase in TG (200 vs. ref range of 35-135F) generally HD & PD patients are at increased risk for coronary artery dz and stroke. TGs are especially increased in PD patients due to glucose uptake in dialysate (Nelms, 2011, p. 539). Abnormal significance of high TG levels: liver dz, gout, pancreatitis, alcohol abuse, MI, diabetes, PD, steroids, or nephrotic syndrome (Nelms, 2011, p. 534).

• High pH (7.9 vs. ref range of 5-7)

• Positive protein balance (2+ vs. ref range Neg) indicates kidney damage. Damage to the tiny blood vessels in the kidneys allow albumin to leak into the urine. Diabetes and high blood pressure are two conditions that can damage these vessels. If not managed properly, the damage can accelerate over time.

• High WBC count (20 vs. ref range of 0-5) high altitude, temporarily with strong emotion, throughout the day, cold shower, reduce plasma volume, or dehydration (Nelms, 2011, p. 534).

• Abnormal urine output

20. Choose two high-priority nutrition problems and complete a PES statement for each.
Mrs. Joaquin’s two high priority nutrition problems include:
1. Excessive sodium related to high sodium foods as evidenced by her diet recall and edema in her extremities.
2. High cholesterol related to consumption of saturated and trans fats in excessive quantities as evidenced by diet recall and labs.

21. For each PES statement, establish an ideal goal (based on the signs and symptoms) and appropriate intervention (based on etiology).
As intervention to the excessive sodium causing edema, educate what foods have less sodium and educate about ways to monitor sodium in the diet to lower fluid retention with dialysis treatment.
To help lower cholesterol, suggest lower saturated fat and educate her on the impact of saturated and trans fats. Educate Mrs. Joaquin on how to reduce the amounts of fats that she is consuming.

22. Why is it recommended for patients to have at least 50% of their protein from sources that have high biological value?
These recommendations are based on the level of protein intake that will maintain neutral or positive nitrogen balance and lead to an improvement or maintenance of visceral protein stores for the majority of hemodialysis patients (Nelms, 2011, p.536). Proteins with high biological value...
value have complete essential amino acids and are easily absorbed into the body tissue. The low biological value proteins are found in plant foods. The toxic urea that often occurs in the CKD patients due to the inability to remove this waste efficiently which is why the 50% of protein from high biological value body conserves protein and decreases urea.

24. Using Mrs. Joaquin’s typical intake and the prescribed diet, write a simple menu. Make sure you can justify your changes and that it is consistent with her nutrition prescription.

<table>
<thead>
<tr>
<th>Diet PTA</th>
<th>Sample Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breakfast:</strong> Cold cereal (¾ C unsweetened), Bread (2 slices) or fried potatoes (1 med potato) 1 fried egg (occasionally)</td>
<td>1 slice Toast (white), rice flake cereal 1c, rice milk ½ c, 1 egg, citrus fruit, small water 2 fluid oz. Justification: limit the milk, cereal low in K &amp; P. Add fluid from water, &amp; egg no fat protein.</td>
</tr>
<tr>
<td><strong>Lunch:</strong> Bologna sandwich (2 slices white bread, 2 slices bologna, mustard) Potato chips, 1 can Coke</td>
<td>2 slices white bread, turkey or ham slices of deli meat low Na+ Mustard 1tsp, corn chips, apple, water instead of coke. Changed deli meat to low Na+ &amp; decreased mustard. Replaced the chips for a desired serving of fruit such as 1 apple or 1 orange or with desired vegetable such as ½ cup of carrot sticks to increase vitamin &amp; mineral intake for a balanced diet &amp; to avoid increase in lipid fat levels &amp; decrease potassium. Replace soda for water to decrease or minimize the phosphorus build up. Replaced the chips decrease potassium &amp; to avoid lipid fat levels.</td>
</tr>
<tr>
<td><strong>Dinner:</strong> Chopped meat (3oz beef) Fried potatoes (1.5 medium)</td>
<td>Lean beef 3oz, asparagus 1c, white bun 1, margarine1T, rice 1c. Replaced the meat to leaner meat. Replaced the fried potatoes with rice to lower the K. Added greens for balanced healthier diet.</td>
</tr>
<tr>
<td><strong>Snack:</strong> Crackers (6 saltines) and peanut butter (2 Tbsp)</td>
<td>Low sodium crackers 6, fresh fruit or jam. Replace the crackers for low sodium alternative &amp; substituted peanut butter for fruit jam as it is lower in K &amp; phosphorus. Increase fruits &amp; vegetables servings. Have half of your plate being vegetables, &amp; maybe save fruit for a snack to avoid high blood sugar levels.</td>
</tr>
</tbody>
</table>
References:


http://www.webmd.com/


http://www.renal.org/information-resources/the-uk-eckd-guide/stages-4-5-ckd#sthash.5gGuN605.dpuf

http://www.unckidneycenter.org/nutrition_phospot.html