The Development of Kidney Stone Dietary Plans for Patient Education

Darwin Dennison, EdD, MS, CNS[1]; M Leah Mayo, BS[2]; Victor E. Abraham, MD[3]

Authors[1-2] are affiliated with the University of North Carolina Wilmington; Author[-3] is affiliated with Coastal Urology, Wilmington, NC. **Contact author**: Darwin Dennison, University of North Carolina Wilmington, College of Health and Human Services, Wilmington, NC 28403 Phone: 910-962-7571; Fax: 910-962-7073 Email: dennison@uncw.edu

Submitted August 29, 2011; Revised and Accepted November 2, 2011

Abstract

Currently patient education programs and urology practices provide individuals with 'lists of foods to avoid' for dietary management of kidney stones. However, 'planned diets' that include daily meal plans and recipes provide structure and specificity for diet management and are preferred by many individuals. This article describes the development of planned diets to assist individuals with treatment and prevention of calcium oxalate kidney stones. The literature does not include planned diets available for individuals with kidney stones; the 'list of foods to avoid' approach is the standard of practice. Results from studies using the Dietary Approaches to Stop Hypertension (DASH) diet with modifications for patients with kidney stones served as the foundation for the planned diets developed in this study. Foods identified in the literature that reduced the development of kidney stones were included in the meal plans. Nutrient analysis was conducted on all foods to ensure nutrient adequacy and compliance with the dietary management of kidney stones. Foods were grouped for meal planning purposes and two sample one-day 2000 calorie planned diets were distributed to 13 patients in an adult urology practice. Adjustments were made in the diets to accommodate for food preferences and caloric levels. Planned diets can provide a useful alternative for community health education specialists in patient health education programs to assist individuals with diet management to reduce the incidence and recurrence of kidney stones.

Key Words: *Diet, dietary management, risk factors, adult, hydration*

Introduction

Kidney stones are known to be among the most painful and prevalent urinary tract disorders.[1,2] More than a half million people per year visit the emergency room with renal colic, abdominal pain commonly caused by kidney stones.[1] Between 1976-1980 and 1988-1994, the prevalence of kidneys stones in the United States increased by 37 percent.[3] Currently in the United States about three million kidney stone events occur per year.[1] About five percent of American women and 12 percent of American men will have some type of kidney stone in their lifetime.[3] Studies have shown that the peak ages for forming stones are ages 20 and 50.[1] Calcium oxalate stones are the most common stone type accounting for about 80 percent of stones.[1-6]

Kidney stones are not only painful, but their diagnosis and treatment are expensive. Kidney stone patients may incur expenses from testing, medications, office visits, and possibly surgery for stone removal.[1] If the individual is able to pass the stones spontaneously, expenses may still be high because of resulting conditions including intense pain, bleeding, and obstruction of a kidney.[1] Estimates have been set at a spending level of $2.1 billion per year on kidney stone related problems.[3]

Kidney stones may not produce symptoms until they begin to move down the tubes (ureters) through which urine empties into the bladder. When this happens, the stones can block the flow of urine out of the kidneys. This causes swelling of the kidney or kidneys, causing pain, often severe.[7] Lack of water advances the accumulation of salts and minerals in urine resulting in formation of solid crystals that become kidney stones.[8] A major risk factor for kidney stones is dehydration.

Individuals having kidney stones must significantly increase hydration and adhere to a dietary intake plan that includes ample fiber and adequate calcium, and limits sodium intake, dietary oxalates, and animal proteins. If dietary intake includes foods that exacerbate the condition or does not include foods that assist with the alleviation of the condition, then medication is used to decrease urinary saturation of calcium oxalate and inhibit its crystallization.[4] Individuals not compliant with dietary recommendations after one calcium oxalate kidney stone have a 50 percent chance of forming more stones.[5] After a dietary treatment plan is followed for two months, follow-up testing is done to determine the effectiveness and compliance with the dietary changes.[9] In the absence of new stone formation or active disease, annual urine testing for kidney stones is recommended.

Customarily, the dietary treatment plan is to provide the individual with a list of foods to avoid without any recommendations for a planned diet that adheres to recommendations. If the 'foods to avoid' list is not successfully utilized by the patient, medication is started to decrease the number of repeated stone events.[2,3] Previous research indicated that individuals prefer and respond more positively to learning which foods and combinations of foods they can consume rather than learning only which foods they must avoid.[10]

Rationale for Diet Modification

Current research indicates highly concentrated urine results in supersaturation of calcium, oxalate, and uric acid.[6,11,12] Supersaturation of these elements greatly increases the risk of forming calcium oxalate stones. High urine calcium, known as hypercalciuria, increases the risk of forming stones and can contribute to osteoporosis. Studies have shown that a high oxalate intake coupled with low calcium intake increases the risk of calcium oxalate stones forming.[1-3] Subsequent studies have found that stone formers should not lower but should regulate their calcium intake to decrease the risk of stone formation and maintain adequate bone density.[2,3,5,6,11,12] This is especially important for older adults who are at higher risk for bone disease.[2,5,6,12] Research indicated that regulating calcium intake combined with lowered sodium and protein intakes was more effective than regulating calcium alone.[6]

Hydration is an integral part of any treatment program aimed at preventing kidney stones. Increased fluid intake maintains a high urinary output diluting the substances within the urine. While fluid intake recommendations vary, a urine output of two or more liters per day is advised.[13]

The Dietary Approaches to Stop Hypertension (DASH) diet was used in a modified format to treat kidney stones.[14] Eight food components related to kidney stones were reviewed: high intakes of fruits, vegetables, nuts and legumes, low-fat dairy products, and whole grains; and low intakes of sodium, sweetened beverages, and red and processed meats. These data plus data extracted from the following studies were examined: Health Professionals Follow-up Study (n =

45,821 men, 18 yr of follow-up); Nurses' Health Study I (n = 94,108 older women, 18 yr of follow-up), and Nurses' Health Study II (n = 101,837 younger women, 14 yr of follow-up). These studies found that there was a 45% reduction in risk of kidney stones in men and a 52% reduction in women whose diets followed the modified DASH diet. The findings indicated that higher DASH scores were related to a marked decrease in kidney stone risk.[15-17]

The importance of women consuming adequate calcium through their diet rather than through calcium supplements was reviewed. Data indicated that women taking calcium supplements were at a 20 percent higher risk of forming calcium oxalate stones than non-supplement users.[2] Researchers have theorized that calcium supplements, usually taken between meals, do not benefit intestinal oxalate binding.[2]

If stone formers are consuming too little calcium, then oxalate has less calcium to bind, leaving more oxalate unbound to cross the GI wall. The oxalate is then absorbed, raising the urine oxalate level.[6,11,12] The same theory applies if adequate calcium is consumed, but too much oxalate is present.[6,11,12] When the calcium and excess oxalate combine they produce ca~ oxalate dihydrate, a highly insoluble salt, which easily forms stones unable to dissolve naturally.[1] To reduce the likelihood that individuals will be recurrent stone formers requires the individuals to increase fluid intake and insoluble fiber, consume adequate calcium, limit sodium intake, limit dietary oxalates, and limit animal proteins.[1,6,11,12]

The formation of kidney stones can be due to low fluid intake or drinking fluids that counter hydration, diet, genetics, work environment, and geographical location.[1,11] Fluid intake and diet are postulated to be major risk factors for forming calcium oxalate kidney stones. Changes in one's dietary and fluid intakes through a treatment plan in a controlled clinical trial has been found to be an effective method to prevent or delay formation of new stones.[11] Individuals with a history of kidney stones or at risk of forming kidney stones are encouraged to complete a 24 hour urine collection for analysis. Individuals with previous kidney stones and/or a genetic predisposition to kidney stones can benefit from dietary intervention.

Methods

To develop the planned diets, sample DASH diets (Dietary Approaches to Stop Hypertension) were used consisting of 2,000 kcalories that adhered to United States Department of Agriculture and Institute of Medicine recommendations.[15] The diets were presented to patients to follow along with instructions for completing daily food records. The food records were analyzed using DINE Healthy, a dietary analysis software program that identifies plant and animal protein as well as plant, animal and fish fats. The steps for designing the planned diets included:

1. Individuals were given a DASH-based diet, asked to follow this diet, and list any modifications allowed by the diet for personal preferences.

2. Individuals completed and submitted three-day food records.

3. Staff reviewed the food records and conducted nutrient analyses to determine adherence to the diet; and then identified modifications to accommodate personal food preferences or caloric intake.

4. From these analyses, two one-day diet plans consisting of meals and snacks were formulated at the 2000 kcal level.

5. Finally, the two meal plans were re-analyzed and then modified for adherence to dietary intake recommendations for minimizing stone development risk.

This developmental study utilized a generalized diet plan based upon the DASH diet adapted for individuals having kidney stones. Analyses of the literature related to risk factor data were used to identify additional foods which could be consumed to help lower the risk for future calcium oxalate kidney stones. Food preferences of the 13 patients in conjunction with DASH diet foods were used to generate the planned diets.

A second dietary analysis was completed using food records. Recommendations for foods to include and avoid were integrated into the dietary meal plans. The diets were designed for individuals with a history of calcium oxalate kidney stones to decrease the stone risk factor values and assist patients with the management of their diets.

Two 2,000 kcalorie diet meal plans were developed. It is postulated that planned diets may be more effective than the "list" format currently used in patient education programs.[2] (see Tables 1 and 2).

Results and Discussion

Two sample one-day 2,000 kcalorie diet plans were formulated using the following criteria for food selection and meal planning. Dietary treatment for kidney stone patients followed adjusted USDA guidelines recommended for a healthy adult. Protein intake required a reduction of the USDA recommended upper limit at 35% to 20% of kcalories per day.[1-3,5,6,9-12] A low oxalate diet should be maintained, limiting oxalate to 40 to 50 milligrams per day.

Oxalate is a by-product of metabolism and is commonly found primarily in plant foods.[1] Plant foods containing the highest amount of oxalate are dark green leafy vegetables, especially spinach having the highest amount of oxalate at 600 milligrams of oxalate per 3.5 ounces.[11] Whole wheat grains are high in oxalate and should be consumed in moderation.[11] One cup (8 ounces) of water is necessary before and after meals to help flush out excess oxalate.[1,11] Dark colored sodas, which will increase oxalate content rather than flushing it out, should not be consumed or considered contributing to fluid intake. Vitamin C intake needs monitoring to avoid an excess in the body as greater than 2,000 mg per day is converted into oxalate in the body.[11]

Meals and snacks are spaced evenly throughout the day. The key to managing a kidney stone condition is to hydrate frequently with water, include foods containing adequate nutrients and limit consumption of foods containing nutrients in excess of recommendations for the condition.

Restriction of foods is not always necessary, but limiting offending foods is imperative. As testing and research in this field continues, the benefits of diet modification for kidney stone patients are becoming evident. The increase and recurrence of kidney stones, particularly calcium oxalate stones, suggest the important role health education specialists and patient educators can play by assisting individuals with dietary plans.

The development of planned diets can provide useful applications for community health education specialists and patient health education programs to assist individuals with the management of their diets to reduce the incidence of kidney stones. The planned diets provide a basis for expansion to include additional days by utilizing the selected basic foods in different meals, recipes and combinations. Additional research is needed to compare dietary treatment modalities. The next step in this process is to evaluate compliance with the list format compared to the utilization of planned diets to determine the impact of dietary management on patients with calcium oxalate kidney stones.

Acknowledgments

Kathryn F. Dennison, EdD, Consultant, DINEhealthy.com .

References

1. National Kidney and Urologic Diseases Information Clearinghouse. (n.d.). National Kidney and Urologic Diseases Information Clearinghouse. Available at: http://www.kidney.niddk.nih.gov.

2. Howard H. The Role of Calcium in the Prevention of Kidney Stones. Journal of the American College of Nutrition. 1999; Vol. 18, No. 5, 373S-378S. Accessed May 17, 2010.

3. Medline Plus. Kidney Stones. Available at: http://www.nlm.nih.gov/medlineplus/ency/article/000458.htm Accessed August 19, 2011

4. WebMD. Kidney Stones – What Increases Your Risk. Available at: http://www.webmd.com/kidney-stones/kidney-stones-what-increases-your-risk. Accessed August 28, 2011

5. Urocit-K (potassium citrate) Information for Health Professionals . (n.d.). Urocit-K Potassium Citrate for Kidney Stone Disease . Available at: http://www.urocit-k.com/For_Health_Professionals/Index.aspx. Accessed May 17, 2010.

6. Flagg L. Dietary and Holistic Treatment of Recurrent Calcium Oxalate Kidney Stones: Review of Literature to Guide Patient Education. Urologic Nursing [serial online]. April 2007;27(2):113-143. Available at: Academic Search Premier, Ipswich, MA. Accessed April 6, 2010.

7. Kidney Stone Prevention Program. LitholinkStone. http://www.litholink.com/gateway.aspx?page=PreventionProgram. Updated 2009. Accessed April 6, 2010

8. Kidney Stone Education Diet Information. LitholinkStone. Available at: http://www.litholink.com/gateway.aspx?page=DietInformation. Updated 2009. Accessed April 2, 2010

9. Evan A. Physiopathology and etiology of stone formation in the kidney and the urinary tract. Pediatric Nephrology [serial online]. May 2010;25(5):831-841. Available at: Academic Search Premier, Ipswich, MA. Accessed May 17, 2010.

10. Quick Guide to Health Literacy and Older Adults - Health Literacy and Older Adults. (n.d.). Available at: www.health.gov. http://www.health.gov/communication/literacy/olderadults/literacy.htm, Accessed April 4, 2010.

11. Krieg C. The Role of Diet in the Prevention Of Common Kidney Stones. Urologic Nursing [serial online]. December 2005;25(6):451-456. Available at: Academic Search Premier, Ipswich, MA. Accessed April 6, 2010.

12. Pak C. Medical Management of Urinary Stone Disease. Nephron Clinical Practice [serial online]. October 2004;98(2):c49-c53. Available at: Academic Search Premier, Ipswich, MA. Accessed April 6, 2010

13. Cornell University, Department of Urology. Kidney Stone Disease/Treatments. Available at: http://www.cornellurology.com/stones/treatments/ accessed August 19, 2011

14. Taylor EN, Fung TT, Curhan GC. DASH-style diet associates with reduced risk for kidney stones. J Am Soc Nephrol. 2009 Oct;20(10):2253-9. Epub 2009 Aug 13.

15. Your Guide to Lowering Your Blood Pressure with ***DASH***. Available at:www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf accessed August 19, 2011

16. Curhan GC, Willett WC, Knight EL, Stampfer MJ. Dietary factors and the risk of incident kidney stones in younger women: Nurses' Health Study II.Arch Intern Med. 2004 Apr 26;164(8):885-91.

17. Taylor EN, Stampfer MJ, Curhan GC. Dietary factors and the risk of incident kidney stones in men: new insights after 14 years of follow-up. J Am Soc Nephrol. 2004 Dec;15(12):3225-32.

Table 1: Planned Diet 1

Breakfast	
Corn Flakes Cereal	2 Cups
Blueberries	¼ Cup
Banana	1 Fruit
Skim Milk	1 ½ Cup
Coffee	1 Cup
Water	1 Cup
Lunch	
Flounder, Broiled	3 Oz
Wild Rice, Cooked	½ Cup
Lemon-Butter Sauce*	2 Tbs
Green Salad	
Romaine Lettuce	2 Cups
Cucumber Slices	½ Cup
Mushroom Slices	¼ Cup
Balsamic Vinegar	1 Tbs
Orange Sections	½ Cup
Water	1 Cup
Dinner	
Spaghetti, Cooked	2 Cups
Marinara Sauce	¼ Cup
Ground Turkey, Cooked	3 oz
Hard Roll	1 Roll
Cantaloupe Melon Cubes	½ Cup
Water	1 Cup
Snacks Between Meals	
Graham Crackers	6 Crk
Raisins	¼ Cup
Skim Milk	1 Cup

*Recipe Available

Planned Diet 1 Totals

Calories	Protein	Animal Pro	Plant Pro	Total Fat	Total Carb	Fiber	Sodium	Vit C	Calcium	Vit K
1954	107 g	77 g	30 g	31 g	310 g	24 g	2173 mg	221 mg	1227 mg	116 mg

Table 2: Planned Diet 2

Breakfast	
Pumpkin Pancakes*	3 Cks
Applesauce	½ Cup
Nonfat Yogurt, flavored	6 Oz
Water	1 Cup
Lunch	
Veggie Wrap	1 Wrap
Wheat wrap, Large	1
Iceberg Lettuce, Shredded	½ Cup
Tomato, Diced	2 Tbs
Carrots, Chopped	2 Tbs
Cucumber, Chopped	2 Tbs
Green Pepper, Chopped	2 Tbs
Almonds, Sliced	1 Tbs
Raisins	1 Tbs
Honey Mustard Dressing	2 Tbs
Peaches, Sliced	½ Cup
Water	1 Cup
Dinner	
Pasta Salad w/Shrimp And Mixed Vegetables*	6 oz
Ginger Sugar Snap Peas*	1 Cup
Apple Crumble*	1 Svg
Water	1 Cup
Snacks Between Meals	
Tortilla Chips	1 Cup
Salsa, Mild	2 Tbs
Sardines	2 Pcs
Orange Juice	1 Cup
Pineapple Chunks	1 Cup

* Recipes Available

Planned Diet 2 Totals

Calories	Protein	Animal Pro	Plant Pro	Total Fat	Total Carb	Fiber	Sodium	Vit C	Calcium	Vit K
1995	77 g	41 g	36 g	35 g	323 g	34 g	2048 mg	183 mg	1181 mg	22 mg