

Patient Information Handout: Your Diet and Kidney Stones

What Are Kidney Stones?

A kidney stone is a hard mass made up of substances excreted by the kidney. Certain substances can form crystals that separate out from the urine and build up on the inner surfaces of the kidney. Although the urine contains chemicals that usually prevent stones from forming, many people are still susceptible. A larger stone can get stuck in the urinary tract, such as in the ureter, the bladder, or the urethra. This can block the flow of urine and cause severe pain.

There are several types of kidney stones. The most common type of stone contains calcium oxalate crystals. These are formed when there is too much calcium or oxalate in the urine. Experts used to think that a diet low in calcium would help prevent calcium-containing stones from forming. The reasoning was that if less calcium is available to be absorbed from the intestines, then less calcium would be excreted in the urine. Experts are now learning that this isn't necessarily true. In fact, a normal intake of calcium can actually HELP prevent kidney stones.

How Does Calcium Help?

Experts now think that limiting calcium in your diet is not necessary to prevent stones. This is important because the risk of developing osteoporosis as you get older is much greater if you don't get enough calcium.

Oxalate is another substance that is excreted in the urine. Experts now think that too much oxalate in the urine is very important in kidney stone formation. Oxalate is formed by the body, but it is also found in food. When eating foods that contain oxalate, the oxalate is absorbed and then excreted in the urine. Dietary calcium can help because calcium binds up the oxalate in the gut. When this happens, the bound oxalate is not absorbed. This lowers the chance of kidney stones forming.

What Can I Do?

- Talk with your prescriber and pharmacist. They can help you find ways to prevent kidney stones. Your prescriber will probably order some tests. These tests will help determine which type of kidney stones you have. This is often necessary in order to decide what steps to take to prevent future stones from forming. There are several dietary changes that can help prevent stones, depending on what type of stones you have. Don't change your diet without talking with your healthcare provider first. Together, you can decide which diet changes are best for you. Your prescriber might also give you some medication to help prevent kidney stones.

- Getting plenty of fluids is extremely important. Water is best. Fluids help to dilute the urine and flush away substances that form kidney stones. Crystals are much less likely to form when the urine is dilute. You should try to drink 2 to 3 liters of water each day.

- If you have calcium oxalate kidney stones, your prescriber may want you to limit how much animal protein and sodium you eat. You should limit your intake of animal protein to 8 ounces or less each day. You should also try to keep your intake of salt to 3 grams or less each day. Eating too much animal protein and salt increases your chance of forming kidney stones.

- Your prescriber may also want you to limit your intake of foods that are high in oxalate. Decreasing the amount of oxalate you get from the foods you eat will decrease the amount of oxalate that is absorbed. Examples of these types of foods are nuts (walnuts, peanuts, almonds, hazelnuts, etc.), spinach, okra, beets, rhubarb, strawberries, cranberries, soy, wheat bran, brown rice, chocolate, coffee, tea, and cocoa.

- If your prescriber says it's okay to take a calcium supplement, try a product containing calcium citrate (*Citracal*, etc.). Citrate is one of the substances in the urine that can help prevent kidney stones from forming. You'll need to take calcium supplements with meals, so that the calcium is available to bind the oxalates in the intestines.

Diet And Recurrent Kidney Stones

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Background

Hypercalciuria is an important and common risk factor for the formation of kidney stones. In fact, about 80% of kidney stones contain calcium and most of these are made up of calcium oxalate. Some calcium stones contain calcium phosphate. A smaller proportion of stones contain uric acid, are struvite stones (caused by urinary tract infections), or are cystine stones. Once a kidney stone forms, there is a 50% probability that another stone will form within five to seven years without treatment. Initial treatment of recurrent kidney stones generally involves changes in dietary habits.¹⁻⁴

It has been thought that decreasing the amount of calcium in the diet reduces the risk of recurrent kidney stones by decreasing the amount of calcium excreted in the urine. However, this idea has been questioned with the suggestion that calcium may even be protective against kidney stones. This idea has prompted a shift toward maintaining normal calcium intake and instead emphasizing lower amounts of animal protein and salt. Because there has been a lack of long-term data on whether a low-calcium diet, or a normal-calcium diet that is low in animal protein and salt, is better in preventing recurrent kidney stones, a recent study was done to provide some answers to the continued debate.^{1,2,5}

Citation

Borghi L, Schianchi T, Meschi T, et al. Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. *NEJM* 2002;346:77-84.

Methods

This randomized trial compared the effects of two different diets in 120 men with recurrent calcium oxalate stones and hypercalciuria. Men were randomly assigned to a low calcium diet or a normal calcium diet. The low calcium diet restricted calcium intake to about 400 mg per day. The normal calcium diet included about 1,200 mg

per day of calcium, but restricted animal protein to 52 grams per day and salt to less than 3 grams per day. Additional protein or calories came from bread, pasta, vegetables, and fruits instead of meat or fish. Both groups were instructed to avoid large quantities of foods rich in oxalate. Both diets included two to three liters of water per day.¹

Twenty-four hour urine specimens were collected at baseline, one week after randomization, and at yearly intervals. Urinary volume, sodium, urea, sulfate, calcium excretion, oxalate excretion, creatinine excretion, and calcium oxalate saturation were measured. The study continued for five years.¹

Results

The primary outcome was the time to the first recurrence of a symptomatic kidney stone or the radiographic identification of a kidney stone. Secondary outcomes were changes in calcium and oxalate excretion, calcium oxalate product, and relative calcium oxalate saturation. Urinary calcium levels dropped significantly in both groups. However urinary oxalate excretion increased in the men on the low-calcium diet, but decreased in the men on the normal-calcium diet.¹

At five years, 12 (20%) men on the normal-calcium diet, and 23 (38%) men on the low-calcium diet had recurrences of stones. The relative risk of recurrence for the group on the normal-calcium diet was 0.49 compared to the group on the low-calcium diet. After adjustment for baseline characteristics, the relative risk of a recurrence was 0.37 in favor of the normal-calcium, low-protein, low-salt diet.¹

Author Conclusions

In men with hypercalciuria and recurrent calcium oxalate stones, a diet containing normal amounts of calcium but reduced amounts of animal protein and salt, works better to prevent recurrent kidney stones than a low-calcium diet.¹

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Commentary

This study provides good evidence that a normal-calcium, low-protein, low-salt diet more effectively reduces the risk of recurrent kidney stones than a diet low in calcium. Two limitations are that this study did not include women, and that bone mineral density tests were not done to determine the effect of the low-calcium diet on bone density.^{1,2}

The primary difference between the two diets appears to be their effects on urinary oxalate excretion. The low-calcium diet does decrease urinary excretion of calcium, but it *increases* urinary excretion of oxalate. The normal-calcium diet decreases urinary excretion of *both* calcium and oxalate. A reduction in urinary excretion of calcium and oxalate, together with an increase in urinary volume by maintaining adequate fluid intake, significantly reduces the relative calcium oxalate saturation in the urine.^{1,2}

The increase in urinary oxalate excretion seen with a low-calcium diet is due to increased absorption of oxalate in the intestines. Dietary calcium binds with dietary oxalate in the intestines to form an insoluble, nonabsorbable complex. This prevents the oxalate from being absorbed and subsequently excreted in the urine. Therefore, the reverse is true for a diet containing normal amounts of calcium; more calcium is available in the intestines to bind with oxalate, which reduces the absorption of oxalate and its subsequent excretion in the urine.^{1-3,6}

The decreased intake of animal protein and salt with the normal-calcium diet plays an important part in reducing calcium stone formation by reducing urinary calcium excretion and supersaturation of calcium oxalate.^{1,2} Decreasing animal protein intake reduces urinary calcium excretion. This is because a diet low in animal protein causes less excretion of acids by the kidney and more reabsorption of bases such as citrate. With a diet low in animal protein it is not necessary for calcium to be released from bone and excreted by the kidneys to help buffer the urinary acid load. Decreasing animal protein intake increases the excretion of citrate which forms a soluble complex with calcium to prevent its crystallization with oxalate. Reduced intake of animal protein is also thought to decrease uric acid excretion, another contributor to kidney stones.^{2,3,5,6}

It is thought that sodium increases urinary calcium, uric acid, and pH while lowering urinary citrate, so lowering sodium intake reduces urinary

calcium excretion and the risk of kidney stone formation.^{2,3,5}

It is important that we now have evidence suggesting that adequate calcium intake is not harmful in most patients with recurrent kidney stones. It has been shown that patients who have a tendency to form kidney stones have a lower bone mineral density than non-stone formers. This increases the risk of osteoporosis.¹⁻³ The effect of calcium on oxalate is also important, because there is much less oxalate than calcium in urine. This means that changes in the urinary oxalate concentration have a greater impact than changes in urinary calcium concentration on the relative supersaturation of calcium oxalate.⁶ However, there may still be patients with persistent hypercalciuria that require modest calcium restriction (1 gram/day).⁵⁻⁷

Patients with recurrent kidney stones often undergo a 24-hour urine collection to determine values for urinary electrolytes. Therapy used to prevent stone formation generally depends on the results of laboratory testing. Patients with calcium stones can have high urinary calcium, high urinary oxalate, low urinary citrate, or high urinary uric acid. For most patients with high urinary calcium, a diet restricting protein, oxalate, and sodium is recommended, but without restriction of dietary calcium. Medications such as thiazide diuretics (usually given with potassium citrate) or amiloride (*Midamor*) can also be used. For patients with high urinary oxalate, dietary restriction of oxalate is recommended. For patients with low urinary citrate, dietary restriction of protein and sodium is recommended. Potassium citrate can also be used. For patients with high urinary uric acid, dietary restriction of purines (usually protein) is recommended. Allopurinol (*Zyloprim*) can also be used.^{3,7}

Patients with uric acid stones might have low urinary pH or high urinary uric acid levels. For patients with low urinary pH, dietary restriction of protein and sodium is recommended. Drugs such as potassium citrate can also be used to alkalinize the urine. For patients with high urinary uric acid levels, dietary restriction of protein and sodium is recommended. Potassium citrate can be used if the urinary pH is low, and allopurinol is sometimes used in selected situations.^{3,7}

Conclusion

Counsel patients with recurrent calcium stones to drink plenty of fluids because adequate urine volume is one of the most important factors in

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preventing kidney stones. The goal is to achieve at least 2 L per day of urine. Patients will need to drink 2.5 to 3 L of fluids with at least 8 to 12 ounces taken at bedtime. Water is best. This amount should be increased when fluid losses are increased.²⁻⁶

Recommend calcium citrate for postmenopausal women with kidney stone disease, because in addition to increasing urinary calcium, it also increases the urinary levels of citrate. Suggest taking calcium with meals so it is available to bind intestinal oxalates. Also advise patients to watch their consumption of foods containing oxalate. Some foods high in oxalate include nuts (walnuts, peanuts, almonds, hazelnuts, etc.), spinach, okra, beets, rhubarb, strawberries, cranberries, soy, wheat bran, brown rice, chocolate, and cocoa.^{1,3-6,8}

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