Kidney Stone Prevention

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Minnesota Urology

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# What is a Kidney Stone?

A kidney stone is hard, crystalline material that forms in the kidney from minerals in the urine. The most common kidney stones (80-85%) are formed from calcium combined with other minerals, oxalate and phosphate. Uric acid stones comprise about 10-15% of all kidney stones. Other possible stone compositions include struvite, xanthine, cystine, and protein matrix stones.

You may hear other names for kidney stones, e.g. renal calculus, nephrolithiasis, urolithiasis, or urinary stone.

A kidney stone may be as small as a grain of sand or larger than a marble.

A small kidney stone will often pass out of the body without causing symptoms. A larger stone may not be able to pass on its own.

Stones that cannot pass through the ureter block the flow of urine, create swelling (hydronephrosis) behind the stone and cause significant pain. Symptoms of kidney stones include extreme pain in your back or side that will not go away, blood in your urine, fever and chills, vomiting, urine that smells bad or looks cloudy, and a burning feeling when you urinate.

The most common way to diagnose kidney stones is with CT (CAT) scanning of the abdomen and pelvis. Other tests such as ultrasound and x-rays of the abdomen can also detect kidney stones. Imaging such as a CT scan is typical performed when a patient has symptoms of a kidney stone but may be performed as well for screening and evaluation for ongoing surveillance of kidney stones.

Treatment for a kidney stone that will not pass on its own requires surgery, either shock wave lithotripsy, ureteroscopy with laser lithotripsy, or a procedure through the back called a percutaneous nephrolithotomy. The type of procedure is determined by the size and location of the stone.

Men have about a 10% chance of forming a kidney stone during his lifetime, women have a slightly lower incidence. After a person gets a stone, he or she has a 30% to 50% chance of getting another stone within 5 years. The average rate of new stone formation in those who develop recurrent stones is 1 every 2 or 3 years.

This PDF is dedicated to helping you with kidney stone prevention and to avoid recurrent stone formation. We hope this handout helps you.

For Anyone Who Has Ever Made a Kidney Stone

For anyone who has ever had a kidney stone the question that automatically comes next is, “how do I prevent these from happening in the future?” The good news for most patients who made their first kidney stone is that there are some simple dietary changes or habits that they can make that will decrease their risk significantly of forming more stones. I will only outline the changes here, as the rest of the PDF goes into more detail.

Two resources that you may want to track down online is the DASH (dietary approach to stop hypertension) eating plan. The DASH eating plan has been shown to decrease kidney stone risk. Copy and paste [*https://www.nhlbi.nih.gov/education/dash-eating-plan*](https://www.nhlbi.nih.gov/education/dash-eating-plan) into a web browser for more information. An alternate resource is a cookbook from the Urology Care Foundation specifically aimed at kidney stone prevention. Copy and paste [*https://www.urologyhealth.org/educational-materials/kidney-cookbook*](https://www.urologyhealth.org/educational-materials/kidney-cookbook) to go to the Urology Care Foundation website.

Here are the six things you should do to help prevent kidney stones.

1. **Hydrate and drink more water and other liquids:** increasing fluids helps make your urine dilute. Drink enough fluids to keep your urine clear, not yellow. This goal will usually require drinking 2-3 quarts or 8-12 cups of liquid per day.
2. **Reduce sodium**: Your chance of developing kidney stones increases when you eat more salt. Salt is in many canned, packaged, and fast foods. It is also in many condiments, seasonings, and meats. Anything in a wrapper has a lot of sodium. Eat less stuff that comes in a wrapper.
3. **Limit animal protein**: Eating high amounts of animal protein may increase your chance of developing kidney stones. Consider replacing some of the beef, chicken, pork, and fish with plant-based foods that are high in protein.
4. **Get enough calcium in your diet**: Even though getting more calcium sounds like it would be a risk factor for calcium-based stones it is not. In the right amount, calcium is good for the body. Your body needs it for normal function and to build strong bones and teeth. Do not restrict your calcium intake. On the other hand, talk with your doctor if you are considering or need to take extra calcium in your diet for osteopenia or osteoporosis and you have had a kidney stone.
5. **Reduce oxalate**: Oxalate combines with calcium to make kidney stone. Diets high in oxalate may put people at risk of forming a kidney stone. Avoid these foods to help reduce the amount of oxalate in your urine: nuts, nut products, peanuts, rhubarb, spinach, wheat bran.
6. **Add some Citrate to your diet:** Citrate in the urine is a stone inhibitor. Liquid in the form of lemonade (Crystal Light) or orange juice can add a small amount of citrate to your diet as well as encourage you to drink more fluid.

Hopefully, these simple recommendations will help spur some dietary changes for you. I would encourage you to follow the website suggestions above to check out the DASH diet (there are many cookbooks specific to the DASH diet) or the link to the Urology Care Foundation cookbook.

# What And Why Is A 24 -Hour Urine and How It’s Done

Some patients are at higher risk for kidney stones because of abnormalities that are chronic in the urine that need to be adjusted with very specific recommendations for diet or with medication.

Kidney stones form over a long period of time. The concentration of your urine over time matters. The concentration of your urine will vary day to day, hour to hour, and even minute to minute. Knowing your average concentration of specific minerals in the urine requires a collection of urine over a long period of time, and one full day serves both as a long enough time to get a representative collection but also an average of your urine output and concentration during the night and day. Maybe most importantly, 24 hours is a reasonable time to expect a person to collect every drop of urine, put it in a container, and get it to our office for analysis once completed.

A 24-hour urine test is a snapshot of your urine production. For this sample to be correct, you must collect all your urine for 24 hours into a container that is provided by your doctor’s office. The container has chemicals that help ensure an accurate reading on the urine. Refrigeration of the urine may also be needed.

Collecting the urine requires a specific sequence to make sure it’s accurate.

1. Pick a time to start the collection and end the collection the next day, 8 am for instance.
2. Empty your bladder completely at the start time and FLUSH IT, don’t collect that urine. The urine in your bladder at the start time was made by the kidneys BEFORE the start time and so it’s not collected. This is a critical step.
3. After the start time until the end time 24 hours later collect your urine every time you go to the bathroom. Every time.
4. At the end time you must empty your bladder and collect it. What is in your bladder at the end time was made by the kidneys during the 24-hour collection time and must be saved.
5. Save the urine, bring it to our office so we can analyse it.
6. Follow-up with a provider to go over results and get recommendations.

But wait, there’s more. Most often patients are asked to do two 24-hour collections for the first analysis to get a better representation of how your urine varies day to day. There will be differences. Some patients do the two 24-hour times back-to-back, but that is not critical in most cases.

Furthermore, patients who have made specific adjustments or who are getting medication will often need to do repeat 24-hour urines to ensure that dietary and/or medication changes are working.

Who should have 24-hour urine testing?

The question of who should be getting 24-hour urine studies is a challenging one to answer. It is impractical to suggest that anyone who has made a kidney stone should be getting a 24-hour test. Most stone formers will reduce their stone risk significantly with the suggestions previously made on page 2 of this handout.

According to AUA guidelines, people can be lumped into one of two categories to help determine what recommendations to make.

A “low risk” stone-former is someone who has made their first kidney stone who does not have a family history, who is not obese or have diabetes, does not have gastrointestinal problems, gout, urinary tract infections, or nephrocalcinosis (small stones forming in the collecting ducts of the kidneys).

A “high risk” stone former is someone who has recurrent or multiple stones, nephrocalcinosis, a strong family history of kidney stone formers, obesity, diabetes, gastrointestinal complaints, gout, and a history of urinary tract infections. Other special considerations include patients with a solitary kidney or other urologic abnormalities. Children and adolescents who have kidney stones are also considered “high risk” stone-formers.

A “low risk” patient often is advised to make the general dietary adjustments, but not the 24-hour urine testing. 24-hour urine testing, however, is easy to do and encouraged if they are motivated to do it.

A “high risk” patient is advised, encouraged, and sometimes pushed to do 24-hour urine testing. Specific abnormalities can often be found in the higher risk patient that require specific adjustment or medication outline in the pages that follow.

There are two exceptions here for the “low risk” patients that will require 24-hour urines or other testing.

1. Certain types of kidney stones will require more involved workup. Kidney stone analysis requires that we send the kidney stone to a laboratory to get the specific type of stone that was made. Patients who have made calcium phosphate, uric acid, cystine or struvite stones are all encouraged to have 24-hour urine tests.
2. A first-time stone former should also have a basic panel of electrolytes drawn from the blood to check for abnormalities that would increase kidney stone risk. Examples of such an abnormality would be an elevated calcium level in the blood that would require evaluation for hyperparathyroidism.

# What Gets Tested in a 24-Hour Urine?

24-hour urine testing seems complicated because there are so many minerals that are tested on the 24-hour urine. It looks daunting to review for the first time. The list, however, is standard: volume of urine, creatinine, pH, citrate, calcium, sodium, oxalate, uric acid, magnesium.

Working though the abnormalities requires a systematic approach.

Here are the steps to evaluating the 24-hour urine.

1. **Is the collection adequate?** Evaluating for adequate collection means checking the creatinine to see if it within a range appropriate for a patient’s body mass. Higher than expected amounts of creatinine could mean an overcollection. Lower than expected an under-collection. When we know that the collection is accurate then we can evaluate the rest of the results. If the collection is not accurate then we advise repeating the 24-hour collection
2. **Is the volume adequate?** Low Urine Output creates a concentrated urine. If your urine volume is less than 1.5 liters/day you need to drink more. Ideally 2-2.5 liters of urine is made daily.
3. **Is the urine acidic or basic?** Very low and very high urine pH levels can precipitate certain types of kidney stones or indicate disease.
4. **Is there hypocitraturia?** Citrate is a stone inhibitor in the urine. Low amounts of citrate can increase stone risk and often requires supplementation.
5. **Is there hypercalciuria?** High amounts of calcium in the urine increases the chance a kidney stone forms.
6. **What is the sodium level?** High amounts of salt in the diet change the way the body processes calcium and other electrolytes in the kidney to get rid of the excess sodium.
7. **Is there hyperoxaluria?** Oxalate is a mineral found mainly in plants. High oxalate levels in the urine often result from a high intake of high-oxalate foods. [(Appendix B)](#_Appendix_B:_).
8. **Is there hyperuricosuria?** Uric acid is a by-product of protein metabolism. High uric acid levels in the urine along with an acidic urine leads to uric acid stones.
9. **Is there hypomagnesuria?** Low levels of magnesium can increase stone risk as magnesium acts as a stone inhibitor in many cases. Magnesium is easily supplemented in the diet.

In the next pages we will review each of these nine questions individually.

# Is the Collection Adequate?

The first part of the test that we look at is the urinary creatinine. Creatinine is a normal by-product of metabolism and is a normal mineral found in the urine. Creatinine does not form kidney stones but is a way for us to test to see if there is an over-collection or an under-collection of urine. For instance, a common reason for an under-collection of urine is for a patient to flush the urine at both the start and end times of the 24 hours. Likewise, a common reason for an over-collection is if a patient saves the urine from the void at the start and end of the 24 hours.

Most of us make a predictable amount of creatinine daily based on our body weight and muscle mass. Urine creatinine (24-hour urine collection) values can range from 500 to 2000 mg/day depending on age and amount of lean body mass.

Another way of calculating the expected normal range for test results is to estimate based on the “lean” body weight of a patient (the muscle, bones, organ parts not the fat part). We expect creatinine outputs in the urine of 14 to 26 (average 20) mg per kg of body mass per day for men and 11 to 20(average 15) mg per kg of body mass per day for women. An example calculation for a lean 180-pound(82kg) man looks like this. 82kg x 20 mg/kg= 1640 mg creatinine expected.

When the creatinine is far off the expected results it most often means there is an error in the collection of the urine. Unfortunately, if there is an expected error in the collection of the urine testing it makes the rest of the results invalid. Most often you will be asked to collect your urine again.

Here’s a quick review on how to collect the 24-hour urine.

1. Pick a time to start the collection and end the collection the next day, 8 am for instance.
2. Empty your bladder completely at the start time and FLUSH IT, don’t collect that urine. The urine in your bladder at the start time was made by the kidneys BEFORE the start time and so it’s not collected. This is a critical step.
3. After the start time until the end time 24 hours later collect your urine every time you go to the bathroom. Every time.
4. At the end time you must empty your bladder and collect it. What is in your bladder at the end time was made by the kidneys during the 24-hour collection time and must be saved.

# Is The Volume Adequate? Low Urine Volume and How To Drink More

One of the most common reasons people make kidney stones is overall low urinary volume. A dilute urine will decrease your risk of forming another kidney stone.

A dilute urine is clear, not dark, or yellow. In absolute terms someone who has made kidney stones should aim for urine output of 2-2.5 liters of urine daily. That’s 2 quarts roughly, or a half gallon.

A 24-hour urine volume is easy to measure and doesn’t take any special equipment. Simply measure your urine volume each time you urinate over 24 hours and add up the total. There is no reason to save the urine just to check the urine volume.

Many people make less than a liter of urine daily.

The solution? Drink more. Almost any liquid will do except for alcoholic beverages. Water is best. Avoid large volumes of soda pop, coffee and tea, and sugar-laden beverages.

Use the eyeball test on your urine. Is it clear? Not clear yellow. Clear, like water. If you have a history of kidney stones and your urine is not consistently clear you are at risk of forming more kidney stones.

Here are some strategies to add liquid to your diet from the Center for Disease Control (cdc.gov)

1. Carry a water bottle with you and refill it throughout the day.
2. Freeze some freezer safe water bottles. Take one with you for ice-cold water all day long.
3. Choose water over sugary drinks.
4. Choose water when eating out. You’ll save money and reduce calories.
5. Serve water during meals.
6. Add a wedge of lime or lemon to your water. This can help improve the taste.
7. Make sure your kids are getting enough water too.

If you need something more specific

1. Drink 8 8oz glasses of water or other liquid daily
2. Drink one glass of water when waking in the morning and one glass of water with each meal.
3. Fill a bottle full of water in the morning and make sure you finish the bottle by the end of the day.
4. Set a repeating alarm each day that reminds you to drink water. There are “smart” water bottles that also can remind you to drink on a schedule to meet your daily needs.
5. Make it a habit. Put yourself in an environment that facilitates drinking more water. For example, set aside a number of water bottles for the day that you will need to drink by day’s end. To quote James Clear from the book *Atomic Habits “*It is important to remember that the environment drives our good behaviors as well as our bad ones. People who seem to stick to good habits with ease are often benefitting from an environment that makes those behaviors easier”. Also, the entirety of the book “Atomic Habits” by James clear is excellent read for anyone trying to change their habits.

# Is the Urine Acidic or Basic?

Urine is most often acidic. But different levels of acidity of the urine will put patients at risk of certain kinds of stones and may indicate certain types of disorders.

A neutral pH in chemistry is a pH of 7. Urine pH can range between 5 and 8 but most often urine pH is around 5.5-6.

Uric acid stones form in very acidic urine. Patients forming many uric acid stones can often be helped by correcting the acidic urine using alkaline agents, such as potassium citrate or sodium bicarbonate. 24-hour urine tests are how we determine if the urine pH is corrected by the medication prescribed.

Calcium phosphate stones form in urine that is more basic with pH levels greater than 6.5. A high urinary pH may indicate a disease process called renal tubular acidosis. In the 24-hour urine results, you typically would see a high urinary pH and hypocitraturia, and less commonly hypercalciuria. In the blood work, typically you would see low serum potassium, bicarbonate, and elevated chloride levels. Your physician will help you evaluate this disorder.

Potassium citrate is a common medication to correct urinary pH levels to treat uric acid stones, as well as renal tubular acidosis. Typical doses for potassium citrate are 10 to 30 mEq twice, three times and even up to four times a day as needed.

Sodium bicarbonate in the form of baking soda can also be used to increase your urinary pH levels. It was previously thought that the sodium load would potentially increase calcium excretion, however this is only seen when the sodium is complexed with chloride. Patients must be conscious of the sodium load of using sodium bicarbonate. The dosing typically used is 650-1300 mg two or three times daily.

# Is There Enough Citrate? How to Treat Hypocitraturia

Citrate is a natural substance found in the urine. It is a byproduct of metabolism and is affected by acid/base balance in the body. Hypocitraturia is low levels of citrate in your urine. Hypocitraturia is diagnosed when total citrate <400mg/day on 24-hour urine collection.

Most hypocitraturia is idiopathic, meaning there is no specific cause. High animal protein diets and low dietary intake of citrate-rich foods such as fruits and vegetables can contribute to hypocitraturia.

Common medical reasons for hypocitraturia are gastrointestinal malabsorption problems related to both medical conditions (e.g. Chron’s disease), kidney specific problems such as renal tubular acidosis, and as complications from surgery. Many gastric bypass or other weight loss procedures create malabsorption that can lead to hypocitraturia and kidney stone formation.

Here are solutions to increase the citrate in the urine.

1. Increasing fresh fruits and vegetables liberally (greater then 5 servings daily) This will naturally increase your urinary citrate, but only a minor change is seen in most cases. Patients with very low levels of citrate will most likely need medication or supplement.
2. Drink orange juice or lemonade. Oranges, lemons, and limes have a high concentration of citrate. Unfortunately, you must drink large amounts of lemonade, lemon concentrate or orange juice to increase citrate levels in the urine. Most often we suggest adding Crystal light lemonade to your fluid intake as an additional step to citrate supplementation if your urine citrate levels are low.
3. Baking Soda: Baking Soda, also known as sodium bicarbonate, can help alkalize the urine and raise urine citrate levels. Sodium Bicarbonate is often prescribed (see #5), but you can also use baking soda you would procure from a grocery store. We recommend ½ teaspoon of baking soda in flavored drink, applesauce or yogurt up to twice a day.
4. Potassium Citrate: This is a supplement that is a concentrated form of citrate. It comes as both a pill and a liquid. The usual starting dose is 15mEq twice a day with meals. Repeat 24-hour urine testing is needed to see if the supplement if effective in raising the citrate levels in the urine. Side effects include GI upset, elevated blood potassium levels, muscle cramps, and tingling in hands.
5. Sodium Bicarbonate: This is not a direct citrate supplement but acts to affect the acid/base balance in the body, thus often increasing citrate in the urine. The usual starting dose is 650 mg twice a day with meals. Side effects include GI upset, decreased blood potassium levels, elevated blood pressure. Patients should also be conscious of the sodium load
6. Citrate supplements from Theralogix including Theralith and Citralith. These are supplements formulated to deliver citrate to the urine. Citralith is the most potent, formulated to deliver 30 mEq of citrate alkali per daily dose. You can find Citralith on the Theralogix website ([https://theralogix.com/collections/urinary-tract-health/products/citralith-kidney-health-supplement?selling\_plan=5035983036 and Theralith](https://theralogix.com/collections/urinary-tract-health/products/citralith-kidney-health-supplement?selling_plan=5035983036%20and%20Theralith)) and Theralith [(https://theralogix.com/collections/urinary-tract-health/products/theralith-xr-vitamin-mineral-supplement?selling\_plan=5036835004)](https://theralogix.com/collections/urinary-tract-health/products/theralith-xr-vitamin-mineral-supplement?selling_plan=5036835004).
7. Make your own Citrate Supplement. (Appendix C)

# Is there too much Calcium? How to treat Hypercalciuria

Hypercalciuria is high levels of calcium in your urine. Most people have less then 200 mg of calcium in the urine every day. The body stores calcium in the bones, uses calcium for normal metabolism, and absorption of calcium is controlled so that there is tight calcium balance in the bloodstream.

Hypercalciuria is urine calcium levels >200mg/day on 24-hour urine collection. The math is simple: higher amounts of calcium in the urine increase the risk for kidney stones.

There are several reasons for increased calcium levels in the urine. Here are the three most common.

1. Excessive sodium intake (>2300mg/day): Sodium affects the way your kidneys process calcium. Sodium and Calcium enter the urine together, and much of this is driven by the amount of sodium in your blood stream. Decreasing sodium levels in the urine will also decrease your calcium levels in the urine. For every 100 mg of reduction in urine sodium you will decrease your urine calcium by 50 mg.
2. Hyperparathyroidism: Occurs when a benign parathyroid gland tumor secretes excess PTH levels, leading to excessive calcium within the urine
3. Poor regulation of calcium within the kidney (renal leak hypercalciuria)

How do I decrease my urinary calcium levels?

1. **Do not restrict calcium in your diet**. First things first. Your body needs it. Get the daily recommended amount of calcium through foods in your diet (1000-1200mg/day). Most people do not need supplements and should not take them. Talk with your doctor if you have bone loss (osteopenia or osteoporosis) to get specific recommendations for you.
2. **Limit your intake of dietary sodium to less than 2300mg/day.** This is difficult but it makes a huge difference. For every 100 mg of reduction in urine sodium you will decrease your urine calcium by 50 mg. Sodium adds up fast, so you must read labels and keep an accurate record.
3. **Take the medications prescribed for you.** Thiazide diuretics is the class of medications most used. Thiazide diuretics blocks the transfer of calcium into the urine at the level of the kidney. Side effects of thiazide diuretics include low blood potassium levels, increased urinary frequency, lower blood pressure and increased in blood sugar levels. You must get routine bloodwork to make sure your potassium levels are normal on the medication. Listed below are the common medication names and dosages.
   1. Chlorthalidone: Usual starting dose of 25 mg daily
   2. Hydrochlorothiazide: Usual starting dose of 12.5 mg daily
   3. Indapamide: 1.25 mg daily

# Is There Too Much Sodium? How To Eat Less Salt

Salt. It is vital for life. It makes food taste good and acts as a preservative. But we get far too much of it.

Kidney stone-formers are advised to limit sodium intake to less that 2300 mg per day.

Good luck.

Americans love salty foods. Hot dogs, pizza, popcorn, and chips. Yummy.

But here is the problem. Too much sodium can raise blood pressure, cause heart disease and stroke, and is a risk for several other medical problems including kidney stones.

According to the Center for Disease Control and Prevention much of the sodium we eat daily comes from store bought packaged food and from restaurant meals. Pizza, sandwiches, deli meats, soups, cheese, tacos and burritos, potato chips, fried chicken, scrambled eggs, and omelettes, and perhaps surprisingly, breads and rolls all have high sodium content.

The Dietary Approaches to Stop Hypertension (DASH) eating plan is probably the easiest way to get started. The DASH diet limits fats, sugars, and foods that are high in sodium while emphasizing fruits, vegetables, whole grains, low fat dairy, beans, nuts, fish, lean meats, and poultry. There are many cookbooks you can buy and resources online that use the DASH guidelines.

Here are five simple ways you can reduce sodium in your diet:

1. **Choose fresh foods** over salty, processed foods. Eat more fruits and vegetables. Skip or limit frozen dinners and other high-sodium fare such as pizza, fast food, packaged mixes, and canned soups or broths. Prepare and eat more foods at home.
2. **Go “low or no” with sodium-free or low-sodium foods.** Check the Nutrition Facts Panels on food containers to identify sodium levels. Choose “low,” “reduced-sodium,” or “no-salt-added" versions of foods.
3. **Use more herbs and spices**. Boost flavor with herbs, spices, lemon, lime, vinegar, or salt-free seasoning blends instead of salt or salty seasonings like soy sauce, spice blends, or soup mixes.
4. **Limit the condiments, “fixins,” and side dishes.** Limit your use of condiments such as salad dressings, ketchup, barbecue sauce, and hot sauce. Even consider limiting low sodium versions of soy sauce and teriyaki sauce, which should be used as sparingly as table salt. And go easy on those “fixins” and salty side dishes such as pickles, pickled vegetables, olives, and sauerkraut.
5. **Talk to a nutrition expert** about ways to control your sodium intake. Check with a registered dietitian, doctor, nurse, or other healthcare provider about reducing your sodium intake or your family’s sodium intake.

# I Have Been Diagnosed with Hyperoxaluria, Now What?

Oxalate is a mineral found in plant foods. Some foods have higher oxalate than other foods. Your body has no use for the oxalate you eat, so restricting oxalate has no damaging effects. Most of the oxalate you eat is bound to calcium in the gut and comes out in the stool. Oxalate that is absorbed into the bloodstream must come out in the urine. Limiting your oxalate intake will directly affect your urinary output of oxalate.

Hyperoxaluria is defined as high levels of oxalate in your urine when total oxalate levels in your urine >25 mg/day.

Here are common causes of high oxalate levels in the urine.

1. Excess of food that are high in oxalate (Appendix B).
2. Malabsorption conditions that don’t allow for proper binding of oxalate (Chron’s disease, chronic diarrheal, previous bowel resections and short gut syndrome or gastric bypass or other weight loss surgery.)
3. Excessive vitamin C intake: High vitamin C intake directly leads to high urinary oxalate levels.
4. A rare genetic condition that can lead to inability to break down oxalate is called primary hyperoxaluria.

Here are the common ways to decrease urinary oxalate levels.

1. **Decrease foods rich in oxalate.** This is the main way to decrease your urinary output of oxalate. Appendix B of this PDF is a list of high oxalate foods to avoid.
2. **Vitamin B6** can help process oxalate. You can safely take this supplement. The usual dose is 100mg/day.
3. **Get adequate calcium in the diet**. Calcium binds oxalate in the gut so that it can’t be absorbed. Absorbed oxalate gets excreted in the urine, where it binds to urinary calcium to form kidney stones. Calcium supplements are used in specific malabsorption conditions to bind excess oxalate in the gut so that it can’t be absorbed.

# Is there too much Uric Acid? Hyperuricosuria, now what?

Uric acid is a normal by-product of protein breakdown from the diet. High levels of uric acid in your urine increases the chance of kidney stone formation. Hyperuricosuria is defined as high levels of uric acid in your urine when total uric acid levels >600mg/day on 24-hour urine collection.

Here are the common reasons for hyperuricosuria.

1. High levels of dietary protein intake. This is majority of cases. Animal protein tends to be higher in purines which more commonly leads to higher uric acid levels.
2. In rare cases, it can be caused by chemotherapy agents and a condition called Lesch-Nyhan Syndrome.

Here is how you decrease your urinary uric acid levels.

1. **Decreasing dietary intake of non-dairy animal protein**. Animal protein includes beef, pork, chicken, and fish.
2. **Limiting portion sizes** (i.e. the amount of protein at each meal should not be larger than the diameter of your first)
3. For patients that fail to adjust the uric acid based on diet changes alone a medication call **Allopurinol** can decrease uric acid production. The usual starting dose is 100-300mg/day. Side effects include skin reactions, nausea, and diarrhea.

# Appendix A: Prevention Strategy Based on Urine Abnormality

|  |  |  |
| --- | --- | --- |
| **Urine Abnormality** |  | **Prevention Strategy** |
| **Low Urinary Volume** (<2L/day) |  | Goal: Increase urinary volume to 2-2.5L daily |
| **High Urinary Calcium** (>200 mg/day) |  | * Moderate Calcium consumption (1000-1200mg/day) * Foods high in calcium   + Dairy: Cheese, yogurt, milk   + Juices: Orange, Grapefruit, Apple with added calcium   + Beans, Lentils, Kale, Broccoli, Tofu, Cereal * Do not take calcium supplements/Vitamin D |
| **High Urinary Sodium**  (>200mg/day) |  | * Decrease dietary sodium intake <2300mg/day * Avoid processed foods |
| **Low Urinary Citrate**  (<400mg/day) |  | * Increase fresh fruits and vegetables in diet. * Goal of 5 servings of fresh fruits and vegetables daily * Optional: Use of Crystal Light Lemonade |
| **High Urinary Uric Acid**  (>600mg/day) |  | * Decrease dietary intake of non-dairy animal protein   + - Poultry     - Red meat     - Fish     - Eggs * Limit portion sizes to a “deck of cards” or “diameter of a closed fist” |
| **High Urinary Oxalate** (>25mg/day) |  | * Decrease dietary intake of high oxalate foods that include spinach, beets, rhubarb, almonds, tree nuts * Limit Vitamin C supplementation |
| **Urinary pH** |  | * Potassium Citrate 10-30 mEq up to 4 times a day |

# Appendix B: High Oxalate Foods

| OXALATE-RICH FOODS1 | | |
| --- | --- | --- |
| FOOD ITEM | SERVING SIZE | OXALATE CONTENT (mg/serving) |
| Spinach, cooked | ½ cup | 755 |
| Spinach, raw | 1 cup | 656 |
| Rhubarb | ½ cup | 541 |
| Rice bran | 1 cup | 281 |
| Almonds | 1 ounce or 22 kernels | 122 |
| Miso soup | 1 cup | 111 |
| Baked potato with skin | 1 medium | 97 |
| Corn grits | 1 cup | 97 |
| Bulgur, cooked | 1 cup | 86 |
| Beets | ½ cup | 76 |
| Navy beans | ½ cup | 76 |
| Cocoa powder | 4 teaspoons | 67 |
| Hot chocolate (homemade) | 1 cup | 65 |
| Bran flakes with raisins | 1 cup | 57 |

Harvard School of Public Health Nutrition Department [Internet]. Oxalate table of foods [cited 2010 Nov 23]. Available at: http://regepi.bwh.harvard.edu/health/Oxalate/files.

# Appendix C: How to Make Your Own Potassium Citrate

This recipe for making potassium citrate from powder at home I received from one a patient.

