Gout, Kidney Stones and the Ketogenic Diet

Contributed by Michael P. Ciell, RPh, Senior Scientific Advisor

By far the biggest concern voiced against the Ideal Protein Program is the notion that a protein-based, ketogenic diet is somehow unhealthy and causes gout and/or kidney stones. This opinion is shared by many medical practitioners as well as dieters. Many of our competitors are believed to only use a ketogenic protocol for a two week induction phase before adding sufficient carbohydrates to bring the dieter out of ketosis.

Other similar programs avoid ketosis completely, giving a hypocaloric diet with a minimum amount of protein (like us) but keeping enough carbohydrates in the diet so as to preclude ketosis and avoid dealing with the issues of gout and kidney stones. This type of program would be adequate for the at home, DIY dieter, requiring very little patient monitoring. While the patient will lose weight on these programs, they will not experience all the benefits they would get on a true ketogenic method. First, it will take them longer to attain their goal weight, a ketogenic diet is the most efficient means to lose fat. More importantly, by maintaining a fair amount of carbohydrates in the diet, the patient has little chance to actually reset the pancreas and give the cells enough time to regain their insulin sensitivity. A true medical grade protocol, such as the Ideal Protein Weight Loss Method, should offer **all** of these benefits and patients suffering from the symptoms of Metabolic Syndrome should not accept less.

Protein Diets Cause Elevated Levels of Uric Acid

This is a common misconception. It is true that a diet strictly composed of fats and whole food proteins, such as the classic Atkins Diet would probably raise uric acid levels but not all proteins are created equal. Uric acid (in vivo) is produced by the action of the enzyme xanthine oxidase on chemical entities called purines. Pure proteins do not contain any purines. Pure proteins are protein isolates and albumin (or egg white). Purines are part of the DNA and RNA structure in the cell. Therefore when one consumes a lot of cells, one gets a lot of purines (such as a diet containing strictly whole protein sources). Red meats, organ meats (liver, sweetbreads, brains, tripe), fermented foods (lots of yeast cells) such as cheese, beer, wine contain a rather high level of purines. Caffeine has a structure similar to a purine and, if acted on by xanthine oxidase, can produce some uric acid. An egg on the other hand, being only one cell (if not fertilized) has an extremely low content of purines (actually, being a sex cell, it only has half of the chromosomes, therefore, only half the DNA and therefore half the purine content of a somatic cell). The main protein sources of protein in the Ideal Protein foods are, whey isolates, soy isolates and albumin but no purines!

Yes, Well, My Friend Went on an Isolate Diet and Got Kidney Stones…

An elevated blood level of uric acid is a common consequence of the Metabolic Syndrome. That being said, it is entirely possible for a patient, placed on a ketogenic diet, albeit one low in purines, to develop gout or kidney stones. Therefore there must be something else coming into play besides a diet high in purines. During ketosis excessive ketone bodies are excreted primarily in the urine but can also be eliminated via the breath (acetone breath) and via feces.

This is particularly true in the beginning weeks of a ketogenic protocol when the cells of the body do not have all of the necessary enzymes readily available to fully utilize these ketones as an energy source, as a result some are excreted. Ketone bodies are slightly acidic and therefore these would tend to make the urine more acidic. If this condition is not addressed it is possible that uric acid stones may form or a gout attack may be precipitated.

Acid Disassociation Constant (pK_a)

Weak organic acids such as uric acid may exist in two forms. One is called the unionized form (think of salt crystals in a salt shaker) and the other form is the ionized or disassociated form (think of the salt crystals now dissolved in a glass of water). The form is dependent upon the pH of its environment, in this case, we speak of blood and urine. The pK_a is the pH at which the acid exists as half ionized, half unionized. The pK_a for uric acid is 5.5, meaning at a pH of 5.5, half of it is like salt crystals and half of it is like the dissolved salt.

In the blood stream, the bicarbonate buffer, the sodium bicarbonate or potassium bicarbonate, reacts with uric acid and produces salts mono-sodium urate and mono-potassium urate[1]

$$KHCO_3 + R\text{-}COOH \rightarrow R\text{-}COOK + H_2CO_3$$

Potassium bicarbonate + uric acid → Mono-potassium urate + Carbonic acid

When potassium bicarbonate is combined with uric acid, it gives us a combination of mono-potassium urate and carbonic acid which then reacts with the enzyme alpha-carbonic anhydrase (with zinc as a catalyst) and becomes water. Carbon dioxide (water) is eliminated as urine and CO_2 is of course exhaled. The same reaction occurs if sodium bicarbonate ($NaHCO_3$) is the buffer and of course the salt mono-sodium urate would be produced.

In simpler terms, remember that the body tightly controls the pH of the blood and maintains it between 7.3 and 7.4. This means that because pH numbers are logarithms (powers of ten), uric acid in the blood exists more than a hundred fold in the ionized (dissolved form) over the unionized form. At a pH of 5.5, they exist in equal parts, so if we raise the pH to 7.4 (a hundred fold increase) the ionized form is the predominate species. As the environment becomes more alkaline to the pK_a (higher pH number) the more of the acid/salt becomes ionized and no crystals will form.

Another factor that also comes into play, is the concentration of the acid/salt. Think of dissolving salt in a glass of water, as you put in the salt it readily dissolves. You keep adding more salt until no more will dissolve. At this point we say the solution is saturated. If you put more salt in, the crystals fall to the bottom of the glass and they precipitate out of solution. Should this happen in the blood stream, the precipitated uric acid crystals may accumulate in a joint and trigger an inflammatory response. This is how gout occurs.

[1] Refer to the section on acid / base balancing in: The Relationship Between Insulin and Glucagon in the Pathogenesis of “Syndrome X” in section four of the Clinic Manual

Into the Kidneys

As the kidneys filter blood in the glomeruli, urine is produced. Uric acid is then actively secreted by the distal tubule. Remember it can exist as two forms, the insoluble unionized form or as the urate salt, which is about 20 times more soluble than its unionized partner. If the urinary pH is 5, precipitation occurs when the concentration of uric acid is only 60 mg per liter of urine. The average human excretes about 400 mg of uric acid daily, therefore a urine with a pH of 5 would require over 6 liters of urine output per day to avoid crystallization! At a pH of 6, this doesn't occur until the urine contains 220 mg of uric acid per liter[2]. The obvious consequence of uric acid precipitation in the renal tubules is stone formation (urolithiasis). The Ideal Protein Weight Loss Method mandates that a dieter consume, at a minimum, 2 liters of water daily along with the alkaline mineral supplements potassium, calcium and magnesium, omega-3 and four cups of green vegetables and two salads. In addition, for every cup of a caffeinated beverage, the dieter will consume an extra cup of water. For the majority of dieters this protocol is sufficient to keep the urine in the pH range of 6 and stone formation will not be an issue.

Special Patient Populations

According to Resnick and Schaeffer, individuals with a predilection for the formation of uric acid stones may be divided into four board categories:

1. Patients with diseases associated to elevated levels of serum uric acid such as gout. About 1/4 of patients with gout form uric acid stones and approximately 1/4 of patients who form stones have had gout at one point.

2. Patients with a propensity to dehydration. These may include those with chronic diarrhea, ulcerative colitis and those with ileostomies.

3. Patients with hyperuricosuria without elevated serum uric acid levels. In men this is defined as excreting over 800 mg of uric acid daily or 750 mg of uric acid output in women. Certain medications such as thiazide type diuretics can increase the excretion of uric acid and lead to stone formation.

4. Patients who form kidney stones despite normal serum levels of uric acid and do not demonstrate hyper secretion of uric acid in the urine. These patients usually have persistent acidic urine. The authors call this condition idiopathic uric acid lithiasis.

Management of Special Patients

The clinician/coach should carefully review the Health Profile checking for a history of gout or kidney stones or conditions conducive to dehydration (i.e. chronic diarrhea, colitis or having an ileostomy bag). Adequate hydration must be given to this group and it would be prudent to increase the daily water requirement to at least three liters per day.

Each centre/clinic should stock a roll of phenaphthazine paper (commonly sold as NitraTest Paper) which can be obtained at a pharmacy or online. Unlike litmus paper, pH paper determines the pH of the urine in the range of 4.5 to 7.5 and dipping a strip of this paper mid-stream will give an accurate reading of the urinary pH. While the majority of dieters will do just fine with an average of 6, the clinician should ensure

[2] Resnick, MJ and Schaeffer, AJ: Urology Pearls. Hanley & Belfus Publishing, First Edition, 1999. P.181

this group maintains a urinary pH of at least 6.5. The dieter may be tested in the office during the weekly follow-up and be given an 8 inch or so strip of paper to take home to monitor their urinary pH daily (they only need about an inch for one test). Results should be brought to the clinician on a weekly basis. It is recommended that the patient test 3 times a day: first urine in morning, midday and before bed. The dieter will follow this procedure until the clinician can determine an average urinary pH. Onwards, only weekly tests (at the follow-up) will be necessary.

Adjusting the Urinary pH

PRESCRIBERS

Medical Doctors, Doctor of Osteopathic Medicine, Nurse Practitioners and Physician Assistants

For the fore-mentioned patient population the following protocol is recommended:

1. Test urine pH at the initial consultation (using pH paper).
2. Retest pH at day 4 of the weight loss method.
3. If pH of urine is not at least 6.5 institute treatment with potassium citrate.
4. Initiate dosage at about 60 milliequivalents (mEq) of K-Citrate (given in divided doses three times a day (TID) to four times a day (QID) with meals) per day. Urocit-K 10 is convenient (2 capsules at breakfast, 1 capsule at lunch, 2 capsules at supper, and 1 capsule with the bedtime snack would be a good starting regimen). For those who have trouble swallowing capsules, liquid forms or packets of crystals are available (Polycitra-K). These are generally available generically and will cost the patient little out-of-pocket.
   Note: Polycitra-K comes as a 30 mEq packet, therefore half of a packet dissolved in water QID would be perfect.
5. Peak levels are reached by day 3, retest urinary pH at the first weekly follow-up. Titrate dosage as necessary to ensure the urinary pH is at least 6.5.
6. Approximately 60 mEqs of K-Citrate will raise the urine pH by 0.7 units.
7. Explain the necessity of adequate hydration! (3 liters of water per day).
8. If it applies, draw a beginning potassium level and repeat at week 3.
9. Potassium sparing diuretics should be discontinued and replaced with a small dose of a loop-diuretic if necessary. Observe other precautions so as not to induce hyperkalemia: (i.e. ACE inhibitors, Rx potassium supplements, etc. may have to be decreased on discontinued while on this therapy).
10. Instruct the patient to take the dose with a meal or within 30 minutes of eating.
11. As the Urocit-K 10 capsules are large, instruct them not to lie down for 30 minutes after swallowing and take with plenty of water.

NON-PRESCRIBERS
Doctors of Chiropractic, etc

The following are non-RX alternatives:

1. Follow the first two bullet points listed above.
2. If pH of urine is not at least 6.5, institute treatment with Sodium Bicarbonate (baking soda).
3. Initiate dosage at 1/2 teaspoonful dissolved in about 4-5 oz. water 3 times a day - between meals. This will provide about 75 mEq's of bicarbonate.
4. Re-check urinary pH at the first weekly follow-up. If urine is not 6.5, add 1 - 2 more 1/2 tsp doses.

Note: Because this regimen provides plenty of sodium, the patient should not use the sea salt and use the higher sodium content foods sparingly! Watch for signs of fluid retention – rings fitting tightly, swollen ankles, slow weight loss, etc.

As an alternative to the above regimen, this protocol may be used:
Give one Potassium and Calcium capsule after each of the four meals and add 1/2 tsp. of baking soda (dissolved in water) between breakfast and lunch and another dose of the same between lunch and supper. This will not provide as much sodium (which may be desirable in some cases) and will form more mono-potassium urate, which is *more soluble than the sodium salt! If this protocol is used, it is IMPERATIVE the clinic contact Michael P Ciell, Senior Science Advisor prior to initiating the regimen. We want to go over any Rx medications and concurrent health concerns (such as a history of arrhythmia) so as to preclude an electrolyte imbalance.*

Finally, remember you can always place these dieters on the Alternative Method if these extra steps are too 'much' for them to follow or, because of complicated Rx drug interactions with potassium supplementation or any other co-morbidity that would make these measures risky. As the patient improves and meds are discontinued, you may of course place the patient on the regular protocol, following the above guidelines.

Obtaining pH Test Paper

I ordered the pH paper online and the cheapest I found was about $41.00 per roll (with shipping), not exactly cheap! I recommend that every clinic should have at least one roll on hand.