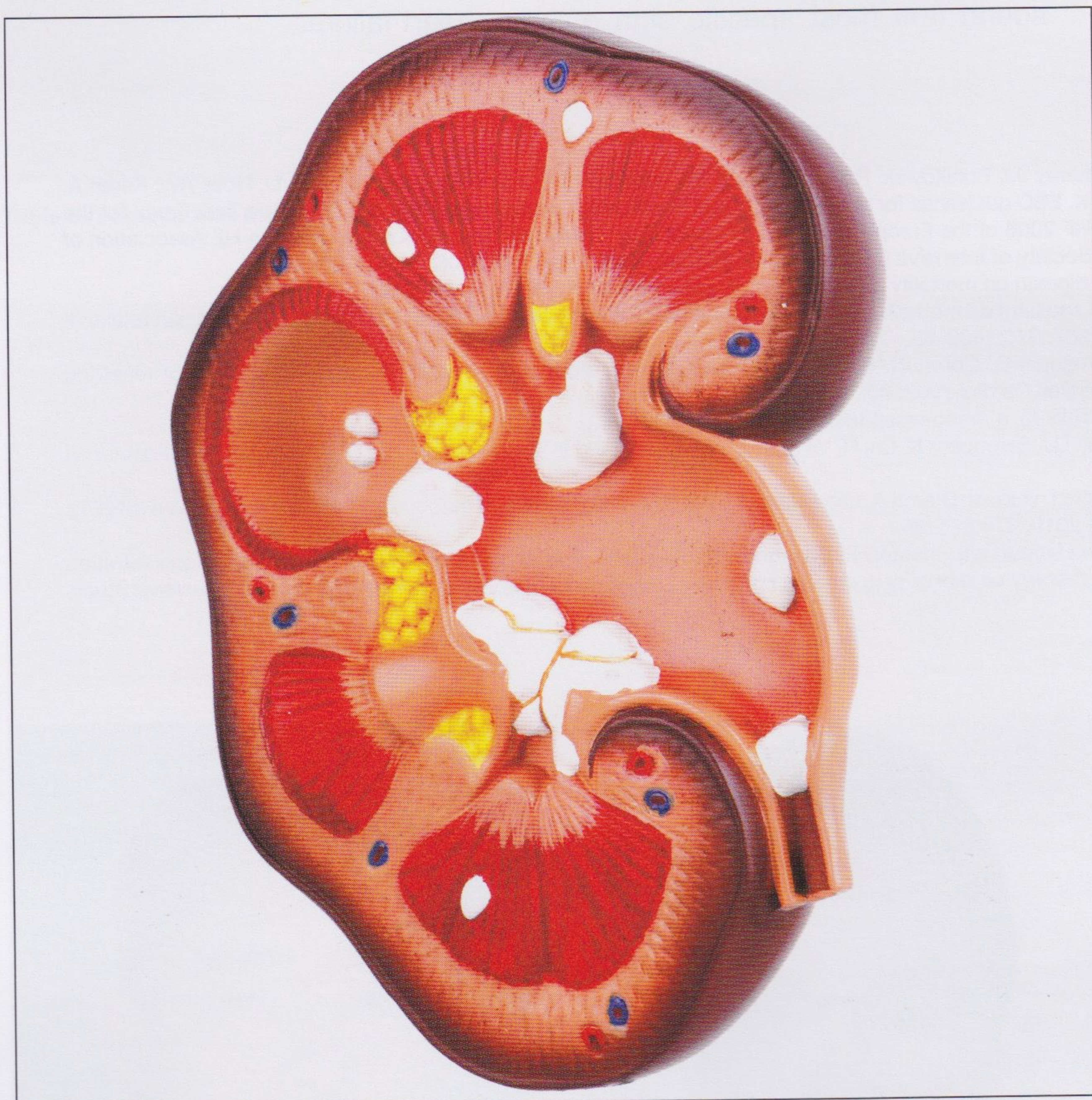


# Metabolic Evaluation of Urinary Stones

What can we do for a patient who been diagnosed with urinary stones?

Mark was sleeping when he had a sudden bout of severe pain in his left back. He was found to have a stone in his kidney and underwent shockwave lithotripsy which resolved the problem.



Urinary stone disease is relatively common and affects 15% of the population, with a slowly increasing trend likely due to increasing rates of diabetes and obesity. Even after treatment, there is a 25 to 50% chance of recurrence in five years. Thus, in many cases, urinary stone disease is a chronic condition, especially if a patient has risk factors of stone recurrence.

So what can be done to prevent a repeat episode?

## EVALUATION

Patients with urinary stone disease should be carefully assessed. The baseline evaluation includes blood

tests to determine uric acid and calcium concentrations and kidney function. In patients with a high risk of recurrence (table 1) a 24-hour urine test should be ordered. In Tan Tock Seng Hospital, we found that up to 95% of patients at high risk of stone formation have abnormalities in the 24-hour urine analysis. Correction of these abnormal urine parameters can significantly reduce the recurrence of stones.

An added benefit of these metabolic evaluations is that underlying systemic diseases that manifest as stone diseases can be picked up, including hyperparathyroidism, renal tubular acidosis and hyperoxaluria.

Onset of disease below 25 years of age  
Multiple stones in kidney  
Calcium phosphate stone  
Solitary kidney  
Presence of remnant stones  
Previous history of stones  
Previous weight loss surgery  
Family history of stones

Table 1. Risk factors for recurrent urinary stone disease.

## MANAGEMENT STRATEGIES

### Dietary management

There are a number of dietary interventions that can be applied to reduce stone recurrence.

### Basic dietary management

First and foremost, patients with stone disease should be encouraged to drink more fluid with a goal of producing at least 2 litres of urine a day unless contraindicated. A study by Borghi et al found that increasing fluid intake would half the risk of recurrent stone disease.<sup>1</sup> Lemonade and orange juice should be encouraged as the citrate in these juices help to reduce stone recurrence. The citrate alkalizes urine and stops stone precipitation. Soft drinks should be avoided as they have been shown to be associated with increased stone episodes.<sup>2</sup>

Patients should also be on a salt-restricted diet. They should aim to consume not more than 3 gm per day which is equivalent to half a teaspoon of salt. This helps reduce urinary calcium excretion, which could precipitate as stones in the urinary system. Animal proteins can raise the uric acid concentration in



the blood (via purine metabolism) and acidify the urine, which together can increase the incidence of calcium oxalate and uric acid stones. Animal proteins intake should be restricted to not more than 0.8 to 1 gm/kg body weight per day. For example, an egg contains 7 gm, a fillet of salmon 22 gm, and 100 gm of chicken is equivalent to 26 gm of protein. In a recent study it was found that fish and chicken actually caused as much uric acid issues as beef.<sup>3</sup>

Fibre and vegetables should be encouraged as they raise pH and reduce incidence of stones by keeping the stones in their soluble state.

I am often asked about the effects of supplements and calcium on stone formation. Vitamin C consumption should be limited to 500 mg per day and unless otherwise specified. High doses of 1gm or more are associated with increased calcium oxalate stone formation as the excess ascorbic acid is converted to oxalate.<sup>4</sup> An adequate calcium intake of 800 mg per day should be adhered to.<sup>5</sup> When taken with high oxalate foods, calcium binds oxalate in the gut and prevents its absorption; so a low calcium diet could lead to excessive absorption of oxalate and subsequently increasing the incidence of calcium oxalate stones. I have advised patients to take a 300-mg tablet of calcium together with high-oxalate meals

to try and ameliorate the effects of oxalate.

I have also been asked about certain diets and their effects on stone disease. The Atkins diet and ketogenic diets are more likely to cause stones whereas the DASH and vegetarian diets tend to reduce stone formation.

#### **Directed dietary management**

With a proper dietary history and 24-hour urine test, we can tailor the dietary management to correct the abnormalities found in the urine test. These interventions may include reducing oxalate, raising citrate and reducing urate in the diet.

I do not routinely ask patients to take a low-oxalate diet unless the history is suggestive of excessive oxalate intake. This is because oxalate is found in many vegetables that have beneficial effects for prevention of stone formation and cardiovascular health. If I have to restrict oxalate, I will just target the main culprit (this is often spinach).

#### **Medications**

In situations where there are significant abnormalities in the 24-hour urinalysis that cannot be corrected by diet alone, medications can be started to help correct the abnormalities. These include potassium citrate, thiazide diuretics and allopurinol depending on the

abnormalities.

For Mark, he was also noted to have bilateral small stones and on his 24-hour urinalysis showed citrate deficit. As it was mild, apart from basic dietary advice, he was advised to increase his intake of citrate in the form of orange juice and lemonade. A repeat 24-hour urinalysis showed that this corrected his citrate deficit and five years on he has not had a recurrence of stone disease.

#### **CONCLUSION**

Urinary stone disease can be a chronic condition. Recurrent stone disease can be prevented if an appropriate approach is taken.



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#### **References**

1. Borghi L, Meschi T, Amato F, Briganti A, Novarini A, Giannini A. Urinary volume, water and recurrences in idiopathic calcium nephrolithiasis: a 5-year randomized prospective study. *J Urol* 1996; 155:839-43.
2. Shuster J, Jenkins A, Logan C, Barnett T, Riehle R, Zackson D, et al. Soft drink consumption and urinary stone recurrence: a randomized prevention trial. *J Clin Epidemiol* 1992; 45:911-6.
3. Tracy CR, Best S, Bagrodia A, Poindexter JR, Adams-Huet B, Sakhaee K, et al. Animal Protein and the Risk of Kidney Stones: A Comparative Metabolic Study of Animal Protein Sources. *J Urol* 2014 Feb 8. pii: S0022-5347(14)00132-3. doi: 10.1016/j.juro.2014.01.093. [Epub ahead of print]
4. Thomas LD, Elinder CG, Tiselius HG, Wolk A, Akesson A. Ascorbic acid supplements and kidney stone incidence among men: a prospective study. *JAMA Intern Med* 2013; 173:386-8.
5. Candelas G, Martinez-Lopez JA, Rosario MP, Carmona L, Loza E. Calcium supplementation and kidney stone risk in osteoporosis: a systematic literature review. *Clin Exp Rheumatol* 2012; 30:954-61.