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Antibiotics Fuel Kidney Stones by Skewing Microbiome Balance

Analysis by Dr. Joseph Mercola | December 31, 2024

STORY AT-A-GLANCE

- Antibiotics such as cefazolin disrupt your kidney's microbiota, reducing beneficial Lactobacillus species and promoting the growth of harmful Enterobacteriaceae, which are linked to kidney stone formation
- The kidney microbiota is generally stable but could shift toward harmful bacteria when exposed to antibiotics, highlighting the need for cautious antibiotic use to maintain a healthy microbiome
- Lactobacillus species play a protective role against kidney stones by degrading oxalate, while Enterobacteriaceae enhance stone formation by promoting crystallization
- Human and mouse kidneys harbor a low-density, antibiotic-sensitive microbiota, which is perturbed by antibiotic exposure, leading to an increase in stone-promoting bacteria
- Oxalates, found in many plant foods, form sharp calcium oxalate crystals that lead to kidney stones, particularly when metabolic flexibility is compromised

Kidney stones (nephrolithiasis) are solid masses composed of minerals and salts that form inside the kidneys. When a stone moves into your urinary tract, it causes intense discomfort and leads to complications if not addressed promptly.

The pain associated with kidney stones is often described as one of the most excruciating forms of pain, rivaling childbirth in intensity. This severe pain occurs in the back or side, along with other symptoms, like blood in the urine, nausea and frequent urination.

Kidney stones significantly impact your daily life, as the pain limits your ability to perform routine activities and affects your overall well-being. Additionally, people with kidney stones experience recurrent episodes, leading to chronic discomfort and anxiety about future stone formation. If left untreated, these stones could lead to more serious health issues, such as kidney damage, infections and even end-stage renal disease, which require dialysis or a kidney transplant.

What Causes Kidney Stones to Form?

Kidney stones affect approximately 9.25% of the U.S. adult population today, with men more likely to develop these kidney stones than women. The prevalence increases with age, particularly in individuals over 70 years old. Among ethnic and racial groups, non-Hispanic Caucasians have the highest prevalence rates.[1]

Conventional treatments for kidney stones often focus on symptom management and prevention of recurrence, typically involving pain relief medications and dietary adjustments. However, these treatments have limitations, such as side effects from the medications. Kidney stones could also recur despite lifestyle changes.

The financial burden of kidney stones on the healthcare system is also significant, with costs reaching up to 9 billion dollars annually.[2] Hence, addressing the factors that contribute to kidney stone formation is essential to prevent these adverse outcomes and reduce the overall impact on individuals and society.

The underlying causes of kidney stones are multifaceted and complex; the primary risk factors include low fluid intake, consuming a high-salt diet and having metabolic conditions, such as hypertension.[3] These conditions alter the chemical environment within the kidneys, and when the balance of minerals and salts in the urine is disrupted, it results in the crystallization of substances like calcium oxalate, forming stones.

Additionally, dietary factors such as high oxalate intake and low calcium consumption contribute to the development of kidney stones. Genetic predispositions and certain medical conditions, like hyperparathyroidism, play a role in increasing your risk as well.[4]

New Study Reveals How Bacteria in the Kidney Influence Stone Formation

A recent study found that an imbalance in the kidney microbiota because of antibiotic use is another major risk factor for kidney stones.[5] In a December 2024 study published in the journal Nature Communications, researchers explored the existence of bacteria within the kidneys and examined how antibiotics affect these organs' unique microbiome.

They aimed to understand the relationship between these bacteria and the formation of kidney stones, specifically focusing on calcium oxalate (CaOx) crystallization, a common component of kidney stones.[6]

The study used advanced imaging techniques to provide direct evidence of bacteria residing in the kidneys through. Using fluorescence in situ hybridization (FISH), the researchers visualized bacteria in both the medulla and cortex regions of the kidney, confirming their presence in specialized environments like nephrons — the functional units of the kidney.[7] This discovery challenges the belief that kidneys are sterile and opens new avenues for understanding kidney health and disease.

The researchers utilized both mouse models and human kidney specimens to investigate the kidney microbiota. In mice, cefazolin, an antibiotic frequently used during surgery, resulted in a significant decrease in beneficial Lactobacillus species and an increase in Enterobacteriaceae — a family of bacteria that includes common urinary tract pathogens like E. coli.[8]

Human kidney samples obtained from biopsies and autopsies also confirmed the presence of distinct microbial communities within different parts of the kidney, such as the glomeruli and tubuli.[9]

The biological mechanisms behind the study findings involve the interaction between different bacterial species and their metabolic byproducts. One of the key findings was that Lactobacillus crispatus (L. crispatus), a beneficial bacterium, played a protective role against kidney stone formation.

It inhibits the crystallization of calcium oxalate by incorporating natural inhibitors, reducing the likelihood of stones from forming. In contrast, pathogenic E. coli bacteria promoted CaOx crystallization by producing compounds that facilitated stone growth.[10]

Simply put, when antibiotics like cefazolin disrupt the natural balance of bacteria in the kidneys, it reduces beneficial Lactobacillus species and allows harmful Enterobacteriaceae to proliferate. These changes in the delicate balance of the kidney microbiome create an environment conducive to stone formation.

> *"[O]ur animal experiment suggests that conventional antibiotics may shift the kidney microbiome towards more pathogenic/lithogenic bacteria.*
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> *As such, to help prevent lithogenesis, good antibiotic stewardship combined with the development of alternative or more targeted bacteriotherapies are needed, such as quorum-sensing inhibitors that target biofilm formation or urinary Lactobacillus probiotics that can restore uroprotective bacteria to the urinary tract,"* the researchers said.

Previous Studies Have Linked Antibiotic Use to Increasing Rates of Kidney Stones in Children

This study isn't the first to investigate the effects of antibiotic use on kidney stone risk. In 2018, the Journal of the American Society of Nephrology (JASN) published a study linking oral antibiotics as a risk factor for kidney stones. Based on health records for 13 million children and adults in the UK, the researchers found that exposure to five classes of oral antibiotics was associated with kidney stones within three to 12 months post-use. The adjusted odds ratio of kidney stones was:[11]

- 1.27 for broad-spectrum penicillin
- 1.67 for fluoroquinolones
- 1.70 for nitrofurantoin/methenamine
- 1.88 for cephalosporins
- 2.33 for sulfas

What's more alarming is that the association was most pronounced among younger children and remained statistically significant for up to five years after exposure, with the exception of broad-spectrum penicillin.[12]

Data also show that kidney stones are now becoming prevalent particularly among teenage girls, with increased antibiotic use in early life and high-ultraprocessed food diets thought to be the key contributors to this trend. According to an article in NBC News:[13]

> *"Because many antibiotics are prescribed unnecessarily in the U.S., [Dr. Gregory] Tasian [a pediatric urologist] called it a 'leading theory' for the increase in children developing kidney stones.*
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> *The earlier a person develops kidney stones, the more time they have to develop a more severe form of the disease and long-term health issues associated with it, Tasian said. Some of the consequences include loss of kidney function, decreased bone mineral density that could lead to fractures, and higher risk of heart disease in adulthood."*

The Longer You Take Antibiotics, the More Disrupted Your Microbiome Becomes

Going back to the featured study, the researchers also demonstrated that the effects of antibiotics on the kidney microbiota were dependent on the duration of treatment. Short-term antibiotic use led to temporary disruptions in the microbiome, with a subsequent recovery once the treatment concluded.[14]

However, prolonged antibiotic exposure had more lasting effects, creating an environment that favored stone-promoting bacteria over protective species. This shift underscores the importance of cautious antibiotic use to maintain a healthy kidney microbiome.[15]

Furthermore, the study identified unique, age-dependent microbial signatures in human kidneys, suggesting that the kidney microbiome evolves over time and influences the risk of non-infectious kidney diseases.

These signatures varied significantly based on kidney function and the presence of disease, indicating that the microbiome plays a role in maintaining kidney health.[16] The stability and responsiveness of the kidney microbiome to antibiotics further highlight its potential impact on overall kidney function and stone risk.

Overall, the research provides compelling evidence that the kidneys harbor a stable and antibiotic-responsive microbiota that plays an important role in calcium oxalate stone formation. By elucidating the mechanisms through which specific bacteria influence crystallization processes, the study paves the way for new approaches to prevent and manage kidney stones through microbiome modulation.[17]

Prevent Kidney Stones by Supporting Your Microbiome

Diagnosing kidney stones is sometimes problematic due to the variability in symptoms and the limitations of imaging tests. While imaging techniques like CT scans and ultrasounds are commonly used, they don't always detect smaller stones or provide a complete picture of the underlying causes.

These challenges highlight the need for a more comprehensive approach that considers the microbiome and other underlying factors. A more holistic perspective that includes microbiome analysis and personalized dietary recommendations helps improve the accuracy of diagnosis and the effectiveness of treatment strategies.

Maintaining a healthy microbiome is essential for preventing kidney stones, as beneficial bacteria play a crucial role in breaking down oxalates that contribute to stone formation. Modern lifestyle factors disrupt this balance, but there are proactive steps to help restore and sustain your kidney-protective microbiome. Follow these strategies to lower your risk:

1. **Optimize your carbohydrate intake —** Consume a minimum of 200 to 250 grams of targeted carbohydrates daily to support your gut microbiome and cellular energy production. For those who are highly active, you might need more.

   Start with simple carbs and to allow your gut to rest, then gradually incorporate complex carbs and starches as your microbiome heals, avoiding high fiber until your gut integrity is restored. My newest book, "Your Guide to Cellular Health," provides an in-depth explanation about this strategy.

2. **Maintain adequate protein consumption —** Aim for approximately 0.8 grams of protein per pound of lean body mass. Include collagen-rich sources to make up one-third of your daily protein intake, which supports gut health and reduces oxalate levels. Balancing your protein sources helps maintain muscle mass and supports overall metabolic health, essential for preventing kidney stones.

3. **Enhance cellular energy production —** Strong cellular energy is vital for maintaining the right bacterial balance in your kidneys and throughout your body. Ensure sufficient carbohydrate intake tailored to your microbiome needs and activity level.

   Incorporate regular sun exposure to boost mitochondrial function, but avoid harsh sunlight until you have eliminated vegetable oils for six months. Consider using pharmaceutical-grade methylene blue at a dosage of 5 milligrams once daily under professional guidance, or spend time grounding in the ocean to alleviate reductive stress.

4. **Avoid processed foods and vegetable oils —** Eliminate processed foods and vegetable oils from your diet to prevent the accumulation of harmful linoleic acid (LA), which disrupts your microbiome and cellular functions.

Focus on healthy fats like tallow, ghee or grass fed butter in moderation. Avoid unnecessary antibiotics and prescription medications that harm your beneficial gut bacteria, opting instead for natural antimicrobial options like garlic or oregano oil when appropriate.

5. **Consider DMSO —** Dimethyl sulfoxide (DMSO) is a remarkably safe naturally occurring compound that helps treat a variety of challenging conditions, including kidney stones. A study of six patients with kidney stones (five of which were confirmed by ultrasound) found IV DMSO resolved the condition in two to three treatments (although one patient had a complete resolution after a single infusion).[18]

Oxalates in Foods Also Lead to Kidney Stones

Oxalates are natural compounds found in many plant foods, including beans, grains, seeds and nuts, fruits, berries and herbs.[19] They're also called dicarboxylic acid, meaning they are composed of two carbon dioxide (CO_2) molecules.

When oxalates bind with calcium, they form calcium oxalate crystals, which are microscopic and razor-sharp and cause significant tissue damage. And because they are not soluble, they accumulate, causing kidney stones to form. Calcium stones are the primary type, making up 80% of kidney stones.[20]

Everyone needs to be concerned about oxalates, not just those dealing with kidney stones or other chronic health issues, metabolic inflexibility or mineral imbalances. The first step is to identify high-oxalate foods and remove them from your diet, until your gut is healed. Some examples include spinach, figs and sweet potatoes.

Healing your gut will help curb the effects of oxalates, but before you do that, you need to address your metabolic inflexibility. When you're metabolically inflexible, it affects your body's ability to produce energy and has a profound impact on your gut health, particularly your large intestine, as it hinders your body's ability to maintain a low-oxygen environment in this organ.

You need a low-oxygen environment in your large intestine because not only does it help keep pathogenic bacteria in check, but it also allows healthy obligate anaerobes to thrive. These are a primitive type of bacteria that cannot survive when exposed to oxygen.

Obligate anaerobes called Oxalobacter formigenes digest oxalate crystals.[21] Using specific enzymes, these bacteria break down oxalate crystals into formate and carbon dioxide. The carbon dioxide then helps retain the low-oxygen environment in your intestine, allowing these primitive organisms to thrive and support your health.

Through simple passive diffusion, the crystals are released and wind up in your intestine where the Oxalobacter continues to digest them until the oxalate toxicity issues disappear.

To put it simply, you need to optimize your metabolic flexibility to maintain a low-oxygen environment in your gut and allow Oxalobacter bacteria to radically reduce the level of oxalates in your tissues.

Apart from being cautious with antibiotic use, I believe this is the ultimate cure for most kidney stones. It's far more efficient and effective than the conventional approach for this common health condition, as it goes straight to the root cause of the problem. To learn more about this topic, read "**Kidney Stones in Children Are Becoming More Prevalent — Here's Why and How to Fight Them**."

Sources and References

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