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Recurrent Symptomatic Renal Stones Managed by Repeat Open Nephrolithotomy in a Rural Kenyan Hospital

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ABSTRACT

Kidney stone disease (nephrolithiasis, urolithiasis, and renal calculi) is characterized by the formation of both symptomatic and asymptomatic obstructive and non-obstructive calculi in the urinary tract. Calcium oxalate stones are the most common type, related to the consumption of large amounts of oxalate-rich foods. Other stones are made of calcium phosphate, hydroxyapatite, uric acid, cystine, and struvite. Urolithiasis is increasingly being reported in both urban and rural Kenya. Minimally invasive surgical treatment of symptomatic stones is the current standard of care, but open nephrolithotomy remains a viable option in selected patients. Nonetheless, the rates of stone recurrence remain high, increasing from 15% at 1 year to 50% at 10 years due to multifactorial risk factors. In this study, we report the case of a rural Kenyan patient who underwent the third open nephrolithotomy in 10 years for recurrent symptomatic stones and whose biochemical analysis has guided subsequent preventative dietary efforts against stone recurrence.

INTRODUCTION

Kidney stone disease (nephrolithiasis, urolithiasis, renal calculi) is characterized by the occurrence or formation of calculi in the urinary tract. It is encountered in primary health care settings, with a prevalence of up to 8.8% in a US survey (10.6% among men vs. 7.1% among women) (Scales *et al.*, 2012). Though initially thought to be rare in indigenous African populations, there have been increasing cases of urolithiasis reported in Kenya over the last four decades (Musau, 2010; Ngugi *et al.*, 2010). The risk of urolithiasis increases with age, from 5.1% in males and 5.8% in females aged 20-39 years to 19.7% in males and 10.6% in females aged 80 years and above (Chewcharat & Curhan, 2021). Symptomatic patients present with renal colic, hematuria, frequency, irritability, dysuria, nausea and vomiting, and features of renal failure in some cases (Khan *et al.*, 2016). 70-80% of all renal stones are composed of calcium oxalate. Other components include calcium phosphate, hydroxyapatite, uric acid, cystine, and struvite (Lieske *et al.*, 2014). Risk factors for urolithiasis include urinary factors such as hypercalciuria (Coe *et al.*, 2016), hyperoxaluria (Owino *et al.*, 2023), hyperuricosuria, hypocitraturia, oliguria, and the urine pH (Ferraro *et al.*, 2024). Dietary factors include a lower fluid intake (Gamage *et al.*, 2020), consuming higher-than-recommended levels of dietary calcium, including supplements (Sorensen, 2014), and taking high levels of oxalate-containing foods, e.g., sweet potatoes, spinach, cabbages, ground nuts, green beans, etc. (Mitchell *et al.*, 2019). Medicinal drugs, e.g., furosemide, acetazolamide, topiramate, laxatives, and long-term steroids, may also promote stone formation (Daudon *et al.*, 2018). Other risk factors include family history, genetic factors, and medical illnesses like hypertension, chronic kidney disease, hyperparathyroidism, diabetes, gout, and obesity (Alelign & Petros, 2018). The American Urological Association and the European Association of Urology have issued guidelines for the diagnosis and management of renal stones (Pearle *et al.*, 2014; Türk *et al.*, 2016). In summary, the diagnostic modalities include a urinalysis (for hematuria and to rule out infections), a non-contrast CT scan of the abdomen and pelvis (the imaging modality of choice), and a kidney-bladder ultrasound (especially in pregnant women). A plain abdominal x-ray may show radio-opaque stones but does not detect hydronephrosis, among other limitations. The management of urolithiasis includes pain control and supportive care, conservative medical expulsive therapy, surgical therapy (i.e., minimally invasive procedures like extracorporeal shock wave lithotripsy, ureteroscopy, and percutaneous nephrolithotomy) (Rodríguez & Sacco, 2015), or open stone removal (Çakici Ö *et al.*, 2017). The current status of practice prefers minimally invasive procedures, but open surgery remains an option (in large, complex stones, among other indications) as per the guidelines. Renal stones have a high rate of recurrence that increases from 15 percent at 1 year, 35 to 40 percent at 5 years, and 50 percent at 10 years (Ferraro *et al.*, 2017). The risk factors for recurrence include a younger age of onset, male sex, pregnancy, dietary factors, obesity,

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diabetes, recurrent urinary tract infections, a high number and size of previous stones, etc. (Vaughan *et al.*, 2019)

Case Summary

A 76-year-old man, a married father of five and a retired head teacher from Nyakach-Koguta, Kisumu County, Kenya, presented to us with a third episode of severe renal colic and recurrent gross hematuria due to symptomatic bilateral renal stones, which were worse on the left side. He had previously undergone two episodes of open nephrolithotomy elsewhere, i.e., in 2014, where he had a bilateral nephrolithotomy, and in 2020, where he had a left nephrolithotomy. In both cases, multiple stones of various sizes were reportedly extracted. Unfortunately, no biochemical analysis of the stones was done then. He had well-controlled hypertension on nifedipine, losartan, and atenolol. Prior to the first episode of kidney stones, he had been on hydrochlorothiazide and nifedipine. He had been regularly using paracetamol and tramadol for pain control. He had no other cardiovascular risk factors and did not smoke or take ethanol. He had no history of recurrent urinary tract infections. He intermittently took tamsulosin-dutasteride tablets for a benign prostate hyperplasia diagnosed two years prior. His vital signs were normal. On physical examination, he was in obvious pain distress, with an abdominal exam showing bilateral posterolateral lumbar scars with marked tenderness over the left lumbar region but no peritonism. A rectal exam showed an enlarged, soft prostate. A urine dipstick showed 3+ blood, and a urinalysis showed no urinary tract infection.

He had a normal creatinine of 0.9 mg/dL, normal random glucose and a complete blood count, and a normal prostate-specific antigen test of 2.4 ng/mL. A prior erect abdominal x-ray showed left-sided radio-opaque renal stones. See figure 1. A plain CT scan of the kidney-ureter-bladder (KUB) showed multiple stones in the left kidney (both obstructive and non-obstructive) and a non-obstructive stone in the right kidney. See figure 2 and the attached CT scan report in figure 3.

Figure 1: A plain, erect abdominal x-ray showing radio-opaque stones in the left kidney (appearing as white crystals, marked with letter L)

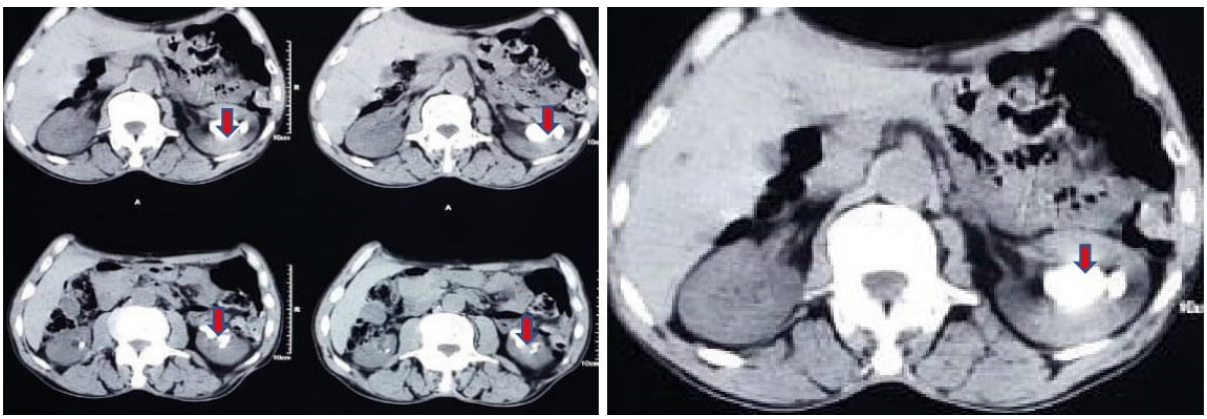
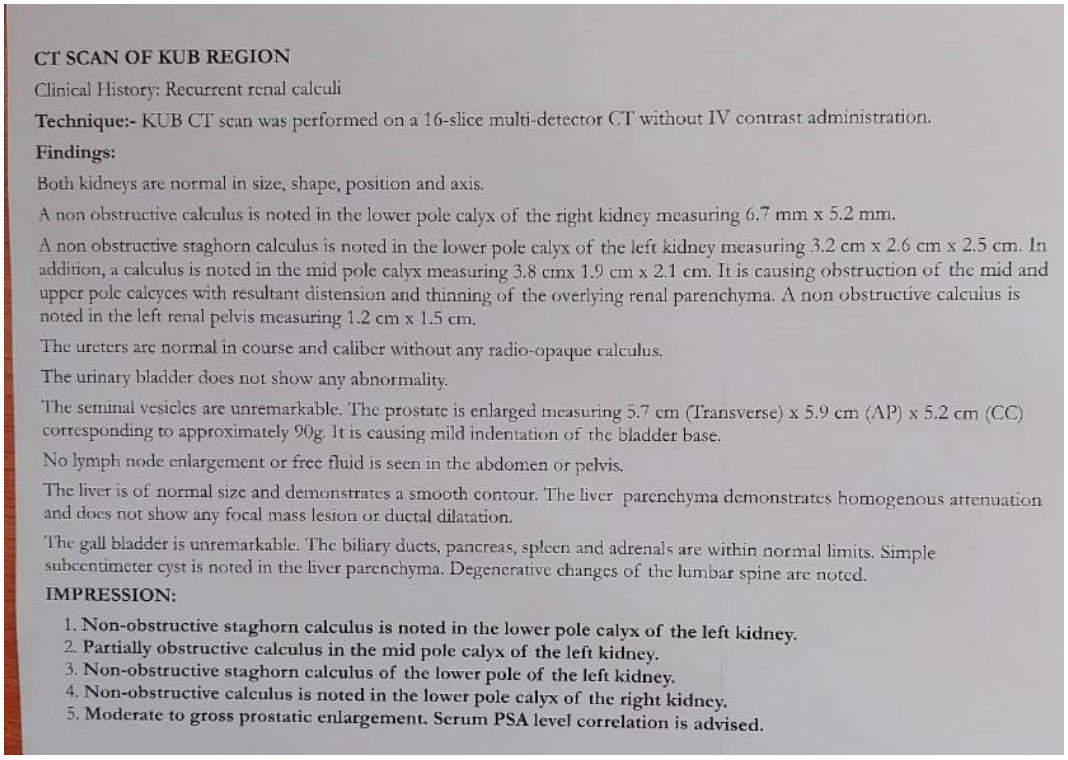


Figure 2: A plain CT scan kidney-ureter-bladder showing multiple radio-opaque stones appearing white, predominantly in the left kidney (marked with red arrows)



CT SCAN OF KUB REGION

Clinical History: Recurrent renal calculi

Technique:- KUB CT scan was performed on a 16-slice multi-detector CT without IV contrast administration.

Findings:

Both kidneys are normal in size, shape, position and axis.

A non obstructive calculus is noted in the lower pole calyx of the right kidney measuring 6.7 mm x 5.2 mm.

A non obstructive staghorn calculus is noted in the lower pole calyx of the left kidney measuring 3.2 cm x 2.6 cm x 2.5 cm. In addition, a calculus is noted in the mid pole calyx measuring 3.8 cmx 1.9 cm x 2.1 cm. It is causing obstruction of the mid and upper pole calcyces with resultant distension and thinning of the overlying renal parenchyma. A non obstructive calculus is noted in the left renal pelvis measuring 1.2 cm x 1.5 cm.

The ureters are normal in course and caliber without any radio-opaque calculus.

The urinary bladder does not show any abnormality.

The seminal vesicles are unremarkable. The prostate is enlarged measuring 5.7 cm (Transverse) x 5.9 cm (AP) x 5.2 cm (CC) corresponding to approximately 90g. It is causing mild indentation of the bladder base.

No lymph node enlargement or free fluid is seen in the abdomen or pelvis.

The liver is of normal size and demonstrates a smooth contour. The liver parenchyma demonstrates homogenous attenuation and does not show any focal mass lesion or ductal dilatation.

The gall bladder is unremarkable. The biliary ducts, pancreas, spleen and adrenals are within normal limits. Simple subcentimeter cyst is noted in the liver parenchyma. Degenerative changes of the lumbar spine are noted.

IMPRESSION:

1. **Non-obstructive staghorn calculus is noted in the lower pole calyx of the left kidney.**
2. **Partially obstructive calculus in the mid pole calyx of the left kidney.**
3. **Non-obstructive staghorn calculus of the lower pole of the left kidney.**
4. **Non-obstructive calculus is noted in the lower pole calyx of the right kidney.**
5. **Moderate to gross prostatic enlargement. Serum PSA level correlation is advised.**

Figure 3: A report of the CT scan of the kidney-ureter-bladder

Due to personal preference, he underwent a repeat open left nephrolithotomy with the extraction of hard, brownish renal stones, as shown in figure 4.

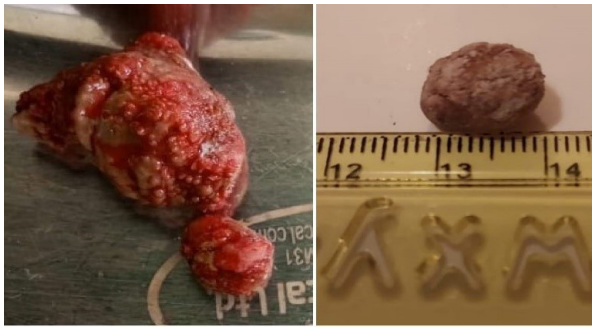


Figure 4: Two large renal stones extracted from the left kidney during open nephrolithotomy. Left: the stones covered by fibrous tissue. The largest stone measured about 2.8cm by 1.6cm; Right: the smaller stone measured about 1cm by 0.8cm.

He had an uneventful postoperative recovery and was discharged six days later. He has remained stable and pain-free four months later. A biochemical analysis of the extracted stones by Fourier-transform infrared spectrometry showed they comprised 80% calcium oxalate, 10% uric acid, and 10% carbonate apatite. See table 1. A detailed dietary history revealed that he is a subsistence farmer who grows and routinely consumes ground nuts, sweet potatoes, spinach, cabbages, and red and green beans. He also routinely takes beef and has variously used over-the-counter calcium supplements. These foods are rich in oxalate and were deemed to be most likely responsible for the recurrent nature of the stones. Besides, he had been taking just about 200-600ml of drinking water on a daily basis. He was advised to avoid oxalate-rich foods, take 2 to 3 liters of drinking water daily, and received a comprehensive nutritional advice to forestall the recurrence of the stones.

Table 1: Biochemical Analysis of the Renal Stones by Fourier-Transform Infrared Spectrometry

Test	Results	Units
Calculi Analysis		
Number of stones	1	
Type	Kidney stone	
Size	2.8 cm	
Color	Brown	
Calcium oxalate monohydrate	80.0	%
Calcium oxalate dihydrate	0.0	%
Calcium phosphate	0.0	%
Uric acid dihydrate	10.0	%
Uric acid anhydrous	0.0	%
Sodium urate	0.0	%
Magnesium ammonium phosphate	0.0	%
Amorphous carbonated calcium phosphate	0.0	%
Ammonium urate	0.0	%
Carbonate apatite	10.0	%
Method of analysis	Fourier-transform infrared spectrometry	

DISCUSSION

Calcium oxalate stones are the most common renal stones in practice. Common foods in rural Kenya that are rich in oxalate include spinach, cabbages, ground nuts, sweet potatoes, bananas, kales (commonly called *sukuma wiki* in Kenya), green beans, tomatoes, etc. Our patient cultivated and consumed these foodstuffs for all his life. Oxalate released from these foods forms compounds with calcium (calcium oxalate), which leads to increased urinary supersaturation, crystal formation, crystal-cell interaction causing tubular epithelial injury, and further crystal nucleation, aggregation, and stone formation (Tsujihata, 2008). This process is compounded by adverse dietary practices, including low fluid intake with resulting low urine volume and thus supersaturation of urine with lithogenic factors, a high animal protein diet causing high levels of calcium and urate to be excreted, a high salt diet that increases urinary calcium excretion, and excessive calcium supplementation (usually by over-the-counter tablets for osteoarthritis), which further increases urinary calcium. Our patient admitted to taking no more than one liter of fluids daily (including 200-600mls of drinking water), regularly taking beef, and using calcium-vitamin D supplements for his osteoarthritis. The patient was given practical dietary advice that included restricting consumption of oxalate-containing foods, increasing the amount of oral fluids to 2-3 liters daily, reducing dietary salt, and consuming a diet rich in calcium (without calcium supplementation) in order to maintain his skeletal health (Prezioso *et al*., 2015). The risk of recurrences of renal stones increases with age, two or more previous histories of stones, male sex, family history, diabetes, obesity, a stone-forming diet, chronic kidney disease, etc. (Vaughan *et al*., 2019). For decades, hydrochlorothiazide has been used to prevent the recurrence of renal stones. However, the recent NOSTONE trial did not show any benefit of hydrochlorothiazide use compared to placebo in preventing the recurrence of stones (Dhayat *et al*., 2023). Our patient was previously on hydrochlorothiazide, which was stopped due to a prior episode of hyperuricemia. He was not put on preventative hydrochlorothiazide thereafter. Minimally invasive therapy is currently preferred for surgically managing symptomatic renal stones. However, in a rural Kenyan setting, patients must be referred to centers (usually in faraway towns) where such services may be available. The services are costly and not readily affordable. This is why our patient (and his family) chose the cheaper, open stone removal approach this time and previously. Besides, he was deemed to have a complex stone burden and thus unlikely to fully benefit from less-invasive approaches (El-Husseiny & Buchholz, 2012). The biochemical analysis of renal stones is only possible in advanced laboratories located in large diagnostic centers and is costly. This is why it had not been done previously for our patient. Obviously, knowledge of the composition of the stones helps guide long-term preventative efforts (Dawson & Tomson, 2012).

CONCLUSION

Renal stones are increasingly being reported in both urban and rural Kenya. Foods that are rich in oxalate, calcium, and urate content; as well as concurrent medical illnesses (among other risk factors), may explain the occurrence and recurrence of renal stones in these populations. Although a minimally invasive surgical approach is preferable for symptomatic stones, open surgery is indicated in selected patients. A biochemical analysis of the stones to determine their exact composition helps guide preventative efforts against stone recurrence.

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