Original Article

Ureterolithiasis: Management in an Environment with Limited Facilities

CA Odoemene, PCN Okere[1], MC Ugonabo[2]

Department of Surgery, Urology Unit, Federal Teaching Hospital, Abakaliki, Ebonyi State, Departments of [1]Radiation Medicine and [2]Chemical Pathology, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State, Nigeria

Abstract

Background: In the past 2–3 decades, there has been a dramatic development in the techniques of stone removal. This study highlights the management of symptomatic ureteral stones in an environment without such facilities. **Materials and Methods:** Sixty-nine patients, comprising 53 (76.8%) males and 16 (23.2%) females, diagnosed of symptomatic ureteric calculi within the study period in two tertiary health institutions were included in the study. Thorough history taking and physical examinations were performed. Extensive laboratory investigations using blood and urine specimens were carried out. Imaging studies, ultrasonography, intravenous urography, and computerized tomographic scan were used to locate the position and size of the calculi. **Results:** Forty-six (66.7%) patients presented with excruciating flank ureteric colic radiating to the groin in 16 (23.2%) patients and hematuria in 62 (89.9%) patients. Bilateral ureteric calculi occurred in 3 (4.3%) patients. Eleven (15%) stones passed spontaneously. 33 (47.8%) patients had uneventful open surgery. The stones were mixed in nature. **Conclusion:** Management of ureteric stones in our environment is affected by delay in presentation, low level of awareness of urinary stone disease, lack of modern endourological equipment, and paucity of urological surgeons. Finally, medical treatment should be explored for stones below 10 mm in size.

Keywords: *Ureteric colic, ureterolithiasis, ureterolithotomy*

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Introduction

The propensity to form urinary stones differs in various parts of the world; 1%–5% in Asia, 5%–9% in Europe, 12% in Canada, and 13%–15% in the USA, with a high prevalence of 20.1% in some Asian countries such as Saudi Arabia.[1-4]

In the tropics, urolithiasis problem as in other parts of the world is on the increase with more of the upper tract.[5-8]

In Nigeria, earlier reports indicated that urolithiasis was rare.[9-11] Later reports showed an increasing incidence.[5,8,12-15]

The nature and type of stones depend on the constituents of the urine, which in turn depends on the nature of the diet consumed in a given population.[2,7,8] Almost all ureteric stones develop in the kidney and become symptomatic when they drop into the ureter causing obstruction. Twenty percent of urinary tract stones are found in the ureters, with 75% of these at the lower one-third otherwise called lower ureteral stones.[4] Below is our experience in managing symptomatic ureteric stones in two tertiary institutions with limited facilities during the study period.

Materials and Methods

Between January 2007 and January 2014, 69 patients diagnosed with symptomatic ureteric stones seen in two tertiary institutions in Southeast Nigeria were prospectively evaluated and included in the study. Clearance was sought and got from the ethical committees of both institutions. Consent of the individual patients was got to take part in the study. The patients were recruited from the emergency departments (EDs) and the urology clinics of both institutions.

Address for correspondence: Dr. CA Odoemene, Department of Surgery, Urology Unit, Federal Teaching Hospital, Abakaliki, Ebonyi State, Nigeria.
E-mail: odoemenec@yahoo.com

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Those who presented with ureteric colic episodes at the emergency units were stabilized by an intramuscular diclofenac sodium injection 75 mg. Detailed history taking was done for all the patients; age, gender, occupation, and dietary and social habits were sought with emphasis on nature, quantity frequency of fluid intake, and animal protein consumption. Geographic location was also noted. Family history of stone forming was asked for. The presence of hematuria and the character of pain were noted; these were followed by a thorough physical examination for each patient.

The following investigations were ordered full blood count, serum electrolytes urea and creatinine, calcium, phosphate, citrate, uric acid, fasting blood sugar. A 24 hour urinary excretion of sodium, magnesium, citrate, oxalate, phosphate, uric acid and cysteine were ordered. Urine microscopy, culture and sensitivity, urine pH and specific gravity were done.

Abdominal ultrasonography (US), intravenous urography (IVU), and computed tomography scan were used to determine the site, size, and burden of stone disease. IVU and US were used to monitor the transit of the stones in those on expectant and medical expulsive therapy (MET), the later comprising tamsulosin tablet 0.4 mg daily plus prednisolone tablet 10 mg daily. Prednisolone was tapered to 1 mg daily. Oral potassium citrate solution 10 ml three times daily for 2 weeks was used for chemical dissolution of radiolucent stones in patients with fasting urine pH of 5.5 or less.

Fasting urine pH was maintained below 7 during the period of treatment. Open ureterolithotomy was the choice of treatment for the impacted stones and those who failed medical therapy after check plain abdominal X-ray on the morning of surgery.

Fifty stones were available for qualitative laboratory analysis using the Uldall A wet chemistry analysis of urinary calculi.[16] All the patients were given preventive dietary advice. Stone clearance was confirmed by IVU and US. There was a follow-up for a minimum of 2 years.

Data collected from the patients during the study were analyzed using both descriptive and inferential statistical analytical tools, namely, tables, pie charts, Pearson's product moment, multiple linear regression analysis, and one-way analysis of variance (ANOVA). All statistical analyses were run using Statistical Package for Social Sciences (SPSS version 17.0, 2008 Chicago, IL, USA).

Results

A total of 69 patients with symptomatic ureteric stones were recruited into the study.

There were 53 (76.8%) males and 16 (23.2%) females, with a male:female ratio of 3.3:1. Age range of patients was between 8 and 72 years, with a mean age of 40.4 years and a standard deviation (SD) of 2.9 years. Twenty-seven (39.1%) and 20 (29%) patients were in the fourth and fifth decades, respectively [Table 1 and Figure 1].

Forty-six (66.7%) patients presented with excruciating flank pain (ureteric colic) radiating to the groin in 16 (23.2%) patients. Relief from the pain was got after a single intramuscular injection of diclofenac sodium 75 mg in 35 (50.7%) patients. Eleven (16%) patients had a second intramuscular dose of diclofenac sodium 75 mg before the pain abated.

There was hematuria in 62 (89.9%) patients [Table 2]. There were a total of 72 stones in 69 patients. Sixty-two (86.1%) out of these 72 stones were radiopaque, while 10 (13.9%) were radiolucent. US detected 58 (80.6%) stones while IVU detected 66 (91.7%) stones [Table 3].

Stone sizes ranged from 3.2 mm to 21 mm, with a mean of 7.2 mm [Figure 2]. Forty-three (59.7%) out of the 72 stones were in the right ureter, while 29 (40.3%) were in the left ureter. Out of these, six stones were bilateral in 3 (4.3%) patients.

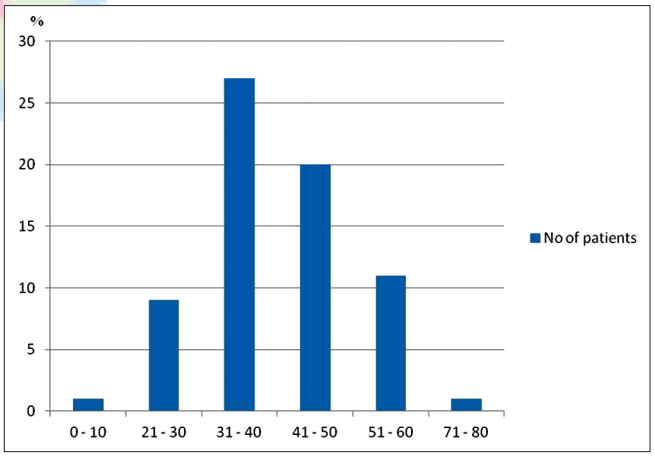

Figure 1: Age distribution in years

Table 1: Age distribution

Age (years)	Number of patients	Percentage of age
0-10	1	1.5
11-20	-	-
21-30	9	13.0
31-40	27	39.1
41-50	20	29.0
51-60	11	15.9
61-70	-	-
71-80	1	1.5

The lower and upper thirds of the ureter harbored 45 (62.5%) and 16 (22.2%) stones, respectively [Table 4].

There were six nonexcreting renal units on IVU [Figure 3]. Comorbid conditions encountered in some patients in this study include diabetes mellitus in 7 (10%) patients, benign prostatic hyperplasia in 1 (1.4%) patient, hypertension in 5 (7%) patients, and urethral stricture in 2 (3%) patients.

Eleven (15.2%) stones were passed spontaneously in 11 (16%) patients. All the stones were in the lower one-third of the ureter and were <4 mm in size. The mean ± SD spontaneous passage time for these stones <4 mm from the time of presentation was 20.5 ± 7.35 days.

MET succeeded in passage of 18 (25%) stones in 18 (26.1%) patients. Three, five, and ten stones were in the proximal, middle, and distal ureter, respectively. The mean ± SD time to expulsion was 13 ± 8.5 days.

There was chemical dissolution with oral potassium citrate solution of 10 (14%) stones in 7 (10.1%) patients. All the patients were males and 5 (71.4%) out of the seven patients had serum uric acid level more than 8 mg/dl and the remaining two had normal serum uric acid level. However, all had hyperuricosuria of >800 mg in 24 h.

Thirty-three (46%) stones, including seven stones that failed medical therapy, were removed after open ureterolithotomy in 33 (48%) patients [Figure 4].

There have been 2 (2.9%) cases of recurrent stone formation after follow-up to 3 years.

Complications after the surgery include wound infection in 5 (15%) patients, ureterocutaneous fistula in 1 (3%) patient due to infection, and ureteric stenosis in 1 (3%) patient.

Fifty (69%) out of the 72 stones were available for qualitative laboratory analysis. There was heterogeneity in the composition of the stones, namely, calcium, magnesium, phosphate, ammonium, and urate/uric acid oxalate [Figure 5]. Figure 6 shows some of the ureteral stones from the patients.

Dietary advice in the form of increased water intake of at least 2 L after each meal and 2 L at about midnight, to produce daily urine volume of 2.5–3 L, low sodium intake, low animal protein, normal calcium, low oxalate, and increased citrate- and magnesium-containing diet.

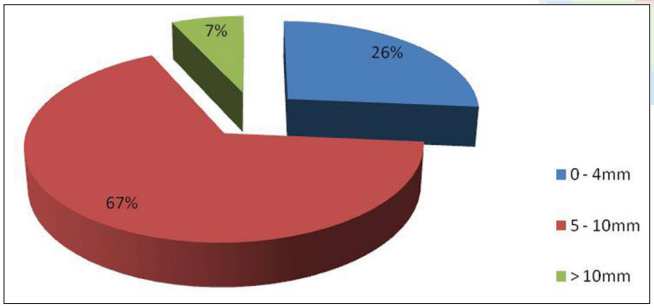

Figure 2: Sizes of the stones in millimeters

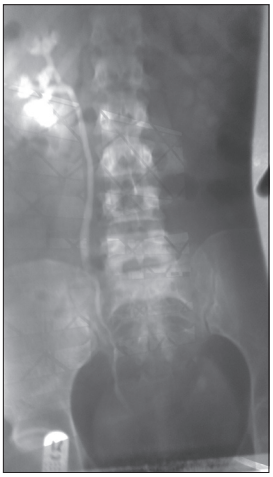

Figure 3: Intravenous urography showing nonexcreting left kidney

Table 2: Presenting signs and symptoms noted in the patients

Symptoms and signs	Number of patients	Percentage of age
Previous history of stone disease	2	2.9
Excruciating flank colicky pain	46	66.7
Flank colicky pain radiating to the groin	16	23.2
Flank pain radiating to the McBurney's point and suprapubic region	13	19
Nausea/vomiting	47	68.1
Pyrexia	31	45
Urinary frequency/urgency	11	16
Hematuria: Gross	41	59.4
Microscopic	21	30.4
No hematuria	7	10.2
Scar of previous abdominal surgery	4	5.8
Anemia (Hb <10 g%)	8	11.6

Hb=Hemoglobin

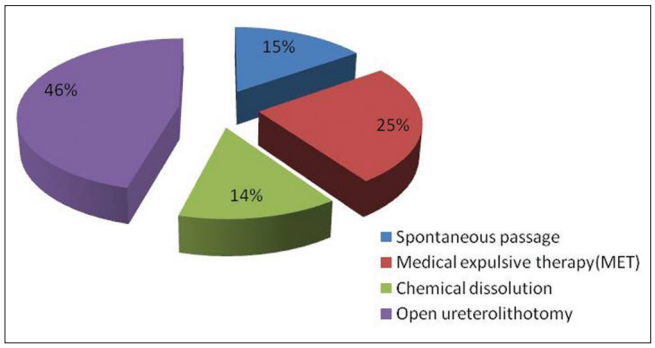

Figure 4: Modalities of treatment

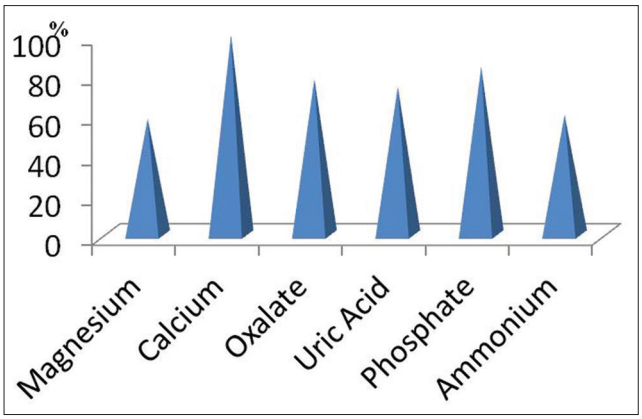

Figure 5: Percentage composition of 50 ureteral stones by qualitative analysis

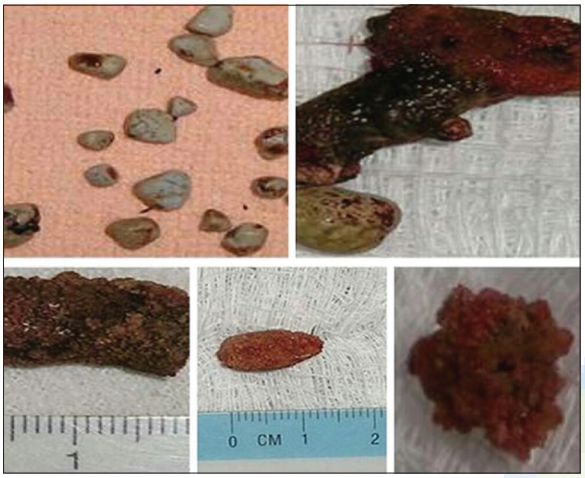

Figure 6: Some of the ureteric stones from the patients

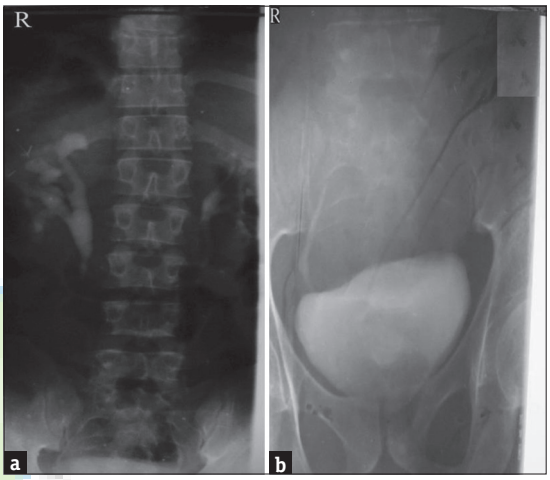

Figure 7: (a) Stone at proximal right ureter before medical expulsive therapy, (b) same stone at the right distal ureter 21 days while on medical expulsive therapy

Table 3: Stone detection with different imaging techniques

Modality	Number of stones	Percentage of age
US	58	80.6
IVU	66	91.7
CT scan	3	4.3

CT=Computed tomography; IVU=Intravenous urography; US=Ultrasonography

Table 4: Location of stones in the ureter

Location of stone	Number of stones	Percentage of age
Right ureter	43	58.7
Left ureter	29	40.3
Bilateral	6	8.3
Upper 1/3 of ureter	10	22.2
Middle third	11	15.3
Lower one-third (intramural inclusive)	45	62.5

Discussion

Stone riddance from the ureter is an integral and pertinent aspect of care of patients with stone disease. It is very challenging particularly in a center with limited resources like ours. In this series, 46 (66.7%) patients were seen in the ED with flank pain otherwise called ureteric colic.

Ureteric colic has been described as the worst pain ever experienced by a patient.[17-21] It is defined as episodic severe abdominal pain from sustained contraction of the ureteric smooth muscle as a kidney stone passes down the ureter into the bladder, accounting for 550,000 room visits costing US$ 3 billion in 2009 in the USA and 25,000 hospital admissions costing €11.6 million in 2012in England.[22] Ureteric colic is a misnomer as the pain does not wax and wane like intestinal and biliary colic, but relatively constant.[23]

These patients with ureteric colic in this study were seen writhing, restless, and in severe distress, trying to find a comfortable position. Some of the female patients described it as being more intense than labor pains. This is in contrast to acute peritonitis where a patient has a board-like abdominal rigidity not wanting to move. These have been noted by other researchers.[17,18,23-25]

The pain of ureteric colic from stone obstruction is due to stretching of the submucosal nerve endings in the lamina propria. Release of prostaglandins stimulates

peristalsis of the ureter to push the stone. Prolonged isotonic contraction of the ureteric smooth muscle from obstruction leads to lactic acid production which in turn irritates both slow Type A and fast Type C pain fibers, which eventually is registered as pain in the cerebral cortex.[18,19,23,25]

In this study, 16 (23.26%) patients comprising 13 males and 3 females had the ureteric colic radiate to groin/testicles and groin/vulva, respectively. Furthermore, radiation of this pain to the McBurney's point and suprapubic region was noted in 13 (19%) patients, while there were associated daytime urinary frequency, nocturia, and urgency in 11 (16%) patients. The explanation here is that there are shared splanchnic innervations of the ureter, other components of the genitourinary system and the gastrointestinal organs.[18,24,25]

Thus, ureteric colic from a stone in upper one-third of the ureter is referred to the testicle since they share similar nerve supply (T11-L2) and gastrointestinal symptoms such as nausea and vomiting experienced in some of these patients were due to reflex stimulation of the celiac ganglion.[18,25] Pyrexia was noted in 31 (45%) patients on presentation most probably due to infection proximal to the ureteric obstruction; this may further complicate ureteric colic and worsen the perception of pain in these patients as noted in another study.[25]

Noted in this study were abdominal scars of nonstone-related surgeries, three appendicectomies and one cholecystectomy in 4 (5.8%) patients before presenting. There was persistence of abdominal pain despite the surgeries. Ureteric colic from the mid-ureter radiates to the McBurney's point and could be misdiagnosed as appendicitis. Such misdiagnosis and patients undergoing unnecessary surgeries have been reported in another study.[5]

Deep intramuscular injection of diclofenac sodium 75 mg was used to treat ureteric colic. Diclofenac is a nonsteroidal anti-inflammatory drug. The analgesic effect is due to inhibition of prostaglandin synthesis and reduces local edema and inflammation.[26] Furthermore, it decreases increased ureteric peristalsis and subsequently ureteric pressure.[17,19,24,25]

Eleven (15%) out of the 72 stones were passed spontaneously. All the stones were <4 mm in size. Spontaneous passage of stone depends on the size and the location in the ureter.[27-30]

Furthermore, it is stated that 56.9% of ureteric stones <4 mm will pass spontaneously, irrespective of location in the ureter.[31] In this study, although the number is small, 11 (57.9%) out of the 19 stones <4 mm passed spontaneously, irrespective of the location in the ureter. The mean (SD) spontaneous passage time for stone <4 mm in this study was 20.5 ± 7.35 days. In another study, the mean (SD) passage time for stones <5 mm in size was 21.3 ± 7.38 days.[27] Abdominal ultrasonography did not detect hydronephrosis or hydroureter in any of the patients, postspontaneous passage of stone. MET comprising of oral tamsulosin tablet 0.4 mg and prednisolone tablet 10 mg was used to expel 18 (25%) of the 72 stones. The localization of alpha 1 adrenoceptor subtypes in the human ureter has made it possible for targeted medical treatment therapy for stones in the ureter. There is presence of alpha 1a, 1b, and 1d subtype receptors in the entire length of the ureter with preponderance of alpha 1d.[32-36]

Tamsulosin is a selective alpha blocker for both alpha-1a and alpha-1d receptors.[32,37] Hence, the reason for its use in this series at a dose of 0.4mg daily for a maximum of 21 days. Furthermore, prednisolone 10 mg daily was added and tapered to 1 mg daily for 21 days. Combination of alpha blockers and corticosteroids is based on the effect on the ureter, which includes reducing ureteric peristalsis, inflammatory edema around the stone, thus facilitating stone expulsion. This has been observed and documented in other studies.[32,36-41] Figure 7a and b shows IVU of a patient taken at 15 days interval showing a stone initially at the proximal ureter and its movement to the distal ureter while on tamsulosin and prednisolone. MET is cost-effective and obviates the need for surgical intervention with its attendant risks. The drugs were well tolerated by the patients.

Pearson's product moment correlation shows that there is a significant correlation (γ =0.609, $P < 0.05$) between stone location and stone sizes, but stone location and stone sizes do not have any significant ($P > 0.05$) correlation or relation with the ages of the patients. This implies that the age of the patients does not have any significant influence on the sizes of the stones or their locations in the ureter. Results of the multiple linear regression showing the interaction between the spontaneous passage of ureteric stones and the explanatory variables and stone sizes and location revealed that the size of the stones significantly explained the spontaneous passage of the stones (with or without drugs) at 60.1% ($P < 0.05$).

The one-way ANOVA test results shows that both stone size and location can combine to give a significant effect (F = 12.8, $P < 0.05$) for spontaneous passage of ureteric stones but stone size has a greater impact.

Ten (14%) out of the 72 stones which were radiolucent on plain abdominal X-ray in 7 (10%) patients with urine pH ranging from 5 to 5.5 were chemically dissolved

using oral potassium citrate solution for 2 weeks. During treatment, the patients were on a low-purine diet and the fasting urine pH was <6 not exceeding 7. A fasting urine pH >7 can enhance the risk of calcium phosphate stone formation. The goal here is to increase the solubility of uric acid in urine and to reduce its concentration by increasing urine volume up to 3 L/day. Other researchers have documented these in their studies.[42,43] Abdominal ultrasonography after treatment showed that the patients were stone free and the symptoms had abated. Open surgery is not the preferred treatment for ureteral stones that failed expectant or medical treatment. Extracorporeal shock-wave lithotripsy (ESWL), ureteroscopy, and lithotripsy are considered the first-line treatment procedures.[44,45] However, there is still a place for open ureterolithotomy in well-equipped endourological centers though limited.[45]

In this study, 33 (48%) patients had uneventful open surgery for ureteral stones. ESWL, ureteroscopy, and laser lithotripsy are nonexistent in our center. Follow-up of these patients was IVU 3 months postdischarge, abdominal US, yearly for 3 years. The complications of wound infections and ureterocutaneous fistula were resolved before the patients were discharged. The ureteral stenosis patient had endoscopic ureteral dilatation in a center with ureteroscopy. All the comorbid conditions were adequately treated before final discharge of the patients.

The heterogeneity found in the chemical composition of stones that were subjected to qualitative analysis is similar to the report in other studies within Nigeria.[13-15,46,47]

This formed the basis for the dietary advice given to patients to prevent recurrence which has been noted in 2 (2.9%) out of the 69 patients.

Conclusion

Management of ureteral calculi in our region is affected by factors which include delay in presentation, misdiagnosis, low level of awareness of urinary stone disease, delay in getting investigation results, poverty, lack of modern endourological equipment, and above all paucity of urological surgeons that can manage the condition effectively. All the patients who needed surgical intervention in this study had open surgery. Finally, expectant and medical treatment should always be explored for stones below 10 mm as this is very cost-effective and avoids surgery and the risks associated with it.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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