Urolithiasis Management in Resource-Limited Settings: A Multicentric Retrospective Study in the Democratic Republic of Congo

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Research note

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Abstract

Objective

This study aimed to analyze different therapeutic modalities used in the treatment of urolithiasis in the Democratic Republic of Congo.

Results

Among the 194 patients included in this study, 69% (n=133) were males, with a male to female ratio of 2.2: 1, and an age mean (SD) of 48.1 (17.3) years. Urolithiasis was symptomatic in 52.6% (n=141) of patients. Renal colic was the most common clinical expression. Overall, 86.1% (n=167) of stones were removed by surgery, 9.8% spontaneously resolved, 3.1% were extracted after ureteroscopy, and 1% of patients had undergone extracorporeal shock wave lithotripsy. Lumbotomy was the most frequent used route (39.2%) in conventional surgery. The mean (SD) size of the extracted stones was 23.4 (17.0) mm.

Most patients in this study were treated by conventional surgery. These results suggest the need to increase the use of minimally invasive surgery.

Introduction

Urolithiasis is a common health problem and a source of morbidity and mortality around the world. Over time, the prevalence of lifetime risk for urolithiasis has been increasing [1-3]. In recent years, treatment options of this condition have evolved, mostly the surgical aspect. The surgical management is currently well standardized, both in emergency situations and in long-term treatment which requires a more complete assessment [4]. Various treatment modalities have evolved over the years. Recently, there have been important advancements in minimally invasive techniques. Treatment modalities include extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), ureteroscopy (URS) and laparoscopic ureterolithotomy. However, discrepancies exist regarding treatment options around the world. In industrialized countries, micro-invasive surgery became the standard of care while conventional surgery accounts only for one percent of treatments [4-5]. On the other hand, in a resource-limited setting such as the Democratic Republic of Congo (DRC), conventional surgery is still widespread and predominant. However, data on the various treatments options in this setting are lacking. Therefore, this study aimed to analyze the different therapeutic modalities used in the treatment of urolithiasis in the DRC.

Methods

Design, setting and period of the study

This was a multicentric retrospective study including patients treated for urolithiasis in various public and private hospitals in the DRC from January 2010 through September 2019. Only patients treated during

this study period and whose stones were analyzed at the Functional Explorations Department of TENON Hospital (APHP, Paris, France) were included. The setting included public and private hospitals in the 4 provinces of the DRC: the city of Kinshasa, Kongo Central Province, Sud Ubangi Province and the province of South Kivu.

Infrared analysis of stones and parameters of interest

The different layers of stones were analyzed by Fourier transform infrared spectrophotometry (Vector 22 FT-IR spectrophotometer, Bruker Optics, Champs-sur-Marne, France) in absorbance mode by accumulation of 32 spectra between 4000 and 400 cm^{-1} , with a resolution of 4 cm^{-1} .

Demographic and clinical data were extracted from the patients' records and included: age, sex, body mass index (BMI), site of the stones, their obstructive nature, the state of the ipsilateral kidney (for stones of the upper apparatus), the circumstances of discovery, the annual frequency, the profession of the patients, the large diameter of the stones, their mode of elimination, the approach used in conventional surgery, as well as the main components of the stones analyzed.

Also, we investigated the association between the mode of elimination, the site of the stones, their average diameter, and the main types of stones analyzed. BMI was categorized into four groups following the World Health Organization (WHO) guidelines; underweight (BMI <18.5), normal/healthy weight (BMI 18.5 to <25), overweight/pre-obesity (BMI 25 to <30), and obesity (BMI $\geq$ 30). The profession was categorized as civil servant, liberal, student / pupil and unemployed. Stones were classified into two categories depending on whether or not their size was greater than 20mm.

Statistical analysis

Continuous variables were expressed as means and medians. Categorical variables were summarized into proportions. Differences in categorical variables between groups were assessed using Chi square test or the chi-square likelihood-ratio as appropriate. Differences in means were assessed by the student's t test. P values less or equal to 0.05 were interpreted as statistically significant. Statistical analysis was performed using SPSS Statistics software version 22 (IBM, Armonk, USA).

Results

Among the 194 patients included in this study, 69% (n=133) were males, with a male to female ratio of 2.2: 1. The ages ranged from 4 to 87 years with a median of 50 years and a mean (SD) of 48.1 (17.3) years. BMI was available for 99 patients, among which 40.4% had normal BMI, 39.4% were overweight, 16.2% were obese, and 4% were undernourished. Compared to males, females had a higher BMI (27.4 ± 4.7 vs. 24.9 ± 4.2 , $p = 0.002$). The upper urinary tract was the commonest sites of lodgment accounting for 61.3% (n=119). Patients with upper urinary tract stones were young and female. ($p \leq 0.001$). The ureters and the pelvi-ureteric junction were the anatomical sites most commonly involved. Ureteral, renal pelvic, and caliceal stones accounted for 26.3% (n=51), 12.9% (n=25), and 9.8% (n=19), respectively.

Among stones lodged at the upper urinary tract, 94 (79%) were obstructive. In 13 patients (11%) the ipsilateral kidney was destroyed (Figure S1).

The lithiasis was symptomatic in 72.3% of patients and its discovery was incidental on medical imaging (ultrasound or standard radiography) in 22.7% of patients or discovered intraoperatively (during surgical treatment of lower obstructive uropathy) in 5% of cases. Renal colic was the most common clinical expression. It was responsible for the flank pain in 107 patients (55.1%) and it was accompanied by vomiting in 26.3% of cases. The other clinical signs included dysuria (11.9%), hematuria (5.7%) and urinary tract infection (1.0%) (Table 1).

Compared to males, females had twice as many stones in the pelvis (19.7% female vs. 9.8% male), in the calyces (16.4% female vs. 6% male) and in the pyelo-calyceal junction (16.4% female vs. 6.8% male) ($p < 0.001$) (Table S 1).

Regarding professional status, 28.9% of patients were unemployed, 16.5% were civil servants, 10.8% were self-employed, and 9.3% were students (Table 2). Obstructive uropathies were 6.5 times more frequent in patients with lower tract stones compared to those with upper tract stones ($p < 0.001$) (Table S 2).

Most of lithiasic patients (85.6%) were treated with conventional surgery. Nineteen stones (9.8%) resolved spontaneously, 6 (3.1%) were extracted after URS, and 2 (1%) were treated by ESWL (Table S 2).

In conventional surgery, lumbotomy (45.2%) was the most used incision (Table S 3).

Upper tract stones cleared spontaneously 2.4 times more often than lower tract stones (12.6% vs. 5.3%, $p < 0.001$) (Table S 2).

Stones containing calcium oxalate (whewellite) predominated (65.5%, $n=127$), followed by anhydrous uric acid (11.3%, $n=22$), and carbapatite (7.2%, $n=14$). Struvite and anhydrous uric acid were the predominant types in the lower tract ($p < 0.001$) (Table 2).

The mean (SD) size of the extracted stones was 23.4 (17.0) mm. Forty-five (60%) stones from the lower tract had a diameter of 20 mm or larger (Figure S 2). The mean size of lower tract stones was twice as large as that of upper tract stones (34.1 ± 21.0 mm vs. 16.6 ± 8.6 mm, $p < 0.001$). Stones that resolved spontaneously had a mean size 2.9 times smaller than that of stones removed by conventional surgery (8.4 ± 3.9 mm vs. 24.8 ± 17.1 mm, $p = 0.005$) (Table 3).

Discussion

Our findings revealed that most lithiasic patients were males and flank pain was the most frequent presenting feature. Urolithiasis was symptomatic in 52.6% of patients and its discovery was incidental (on medical imaging or during surgery) in 20.1% of cases. Renal colic was the most common presenting feature. This is consistent with findings from earlier studies conducted elsewhere [6, 7]. Indeed, clinical features revealing urolithiasis are often unrelated to the chemical type of stones and lend themselves to a

common description. Typical renal colic is the most frequent revealing feature [2, 4]. Pain in renal colic results from the sudden and significant increase in intrapyloric pressure above the urethral obstacle [2, 4, 8-10]. The increase in intrapyloric pressure can be explained by two factors. The first is anatomical due to the presence of a circular edematous ridge in the wall of the ureter around and above the enclosed stone and the second is functional due to an uncontrolled homeostatic reaction with the secretion of prostaglandins E₂; hence justifying the use of non-steroidal anti-inflammatory drugs in the symptomatic treatment of renal colic [2, 4]. Therefore, males patients presenting with flank pain should be carefully evaluated for urolithiasis. Additionally, less characteristic pain or other signs such as hematuria and urinary tract infection should have higher index of suspicion. It should also be noted that typical flank pain is rare in young children. In case of diagnostic doubt, after performing the unprepared abdomen x-ray and ultrasound, the CT scan without injection is now recognized as the preferred imaging examination [5, 11].

Regarding management, our study revealed that most stones (85.6%) were extracted by conventional surgery. This is in line with studies conducted in other sub-Saharan African countries. A study conducted in Cameroon reported that conventional surgery accounted for 96% [12]. In Burkina-Faso, authors reported a 100% use of conventional surgery [13, 14]. However, our findings are in contrast with those from studies conducted in other settings. Indeed, Laziri et al. [15] in Morocco performed modern techniques (ESWL, PCNL and URS) in 72.7% of cases. A study in France reported that URS accounted for 76% of treatment, followed by ESWL (21.3%), PCNL (2.6%), and conventional surgery (0.1%) [16]. Another study in France reported a 100% use of URS [17, 18]. The difference might be explained, at least partially, by the lack of equipment and a limited expertise in most African countries. Current treatment modalities are minimally invasive and include ESWL, URS, and PCNL [19]. However, the use of these techniques poses a huge challenge in our regions. The high cost associated with the acquisition of adequate materials and their maintenance, the lack of qualified personnel to maintain the equipment and the lack of local expertise are obstacles to their implementation. Clinically, the large diameter of stones described in this study poses a challenge with minimally invasive surgery. We performed conventional surgery for stones with destruction of the kidney, stones with associated anatomical anomaly, coralliform stones or obstructive ureteral or pyelic stones with a large diameter. Caliceal stones, sometimes difficult to access with conventional surgery and often responsible for partial renal obstruction, were managed medically until the conditions were met for endourological treatment. Finally, large-diameter bladder stones were systematically treated with conventional surgery.

Besides the constraints related to our setting, it is important to remember that recommendations for surgical management of urinary stones have shifted towards endourological procedures such as URS, PCNL and ESWL [4, 19, 20]. However, ESWL has lost its place as a first-line modality for many indications despite its proven efficacy [19]. Open and laparoscopic surgical techniques have limited indications.

Finally, it is well known that conventional surgery is associated with various complications compared to minimally invasive techniques. However, it offers the possibility of obtaining a urinary tree without calculus ("stone free"). Minimal invasive techniques, beyond their complications such as lesions of the

renal parenchyma (sub capsular, intra and peri-renal hematomas) and arterial hypertension linked to ESWL, do not always offer the possibility of obtaining a urinary tree "Stone free": ESWL 30 to 76% of cases, URS 95% of cases for pelvic ureteral stones and 80% for kidney stones less than 10 mm and 72% for those of 10 and 20 mm and PCNL 80 in 85% of cases [4, 11]. ESWL remains the gold standard for kidney stones and ureteral stones in children, and open surgery is still one of the treatment options for urinary stones in children [11].

The main components of stones were calcium and oxalate, findings which are in keeping with prior studies conducted across various parts of the world [3, 12, 18]

Conclusion

The use of minimally invasive surgery techniques in resource-constrained regions is limited due to the various reasons such as lack of equipment, limited number of expertise, and socio-economic. Thus, preventive measures including balanced and varied diet, adequate fluid intake (>2.5 L daily), and early diagnosis would help mitigate severe cases and complications.

STRENGTHS AND LIMITATIONS

To the best of our knowledge, this is the first study describing urolithiasis management in the DRC. This study was multi-centric including data from various regions across the country. Furthermore, analysis of the chemical composition of the renal stones was conducted. Information on the composition of renal stones is key in understanding the pathophysiology of urolithiasis. However, some limitations should be considered. The relatively low sample size and missing data from some variables such as the BMI. Thus, cautious is warranted while interpreting findings from this study.

Abbreviations

ESWL: extracorporeal shock wave lithotripsy

PCNL: percutaneous nephrolithotomy

URS: ureteroscopy

DRC: Democratic Republic of Congo

BMI: body mass index

WHO: World Health Organization

Declarations

Ethics approval and consent to participate: this study was approved by the ethics committee of the School of Public Health of the University of Kinshasa (approval number: ESP / CE / 29/2020). Participation of human research subjects conformed to institutional review board guidelines, applicable laws, and the World Medical Association Declaration of Helsinki.

Consent for publication: not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Authors' contributions: PD, DM designed, collected, interpreted, wrote and corrected the manuscript. EM, AN analyzed the data, read and corrected the article. MD, JRM, ES and ML read and edited the article, APM, SF and JPH supervised, interpreted and edited the article. All authors have read and approved the final version of the article.

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Authors' information (optional): not applicable

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Tables

Table 1. Demographic and clinical characteristics

Characteristics	n=194(%)
Age, median (years)	50
Male, n (%)	133(68.6)
Female, n (%)	61(31.4)
Presenting clinical features, %	
Flank pain	107(55.1)
Dysuria	23(11.9)
Nausea/vomiting	51(26.3)
Haematuria	11(5.7)
Urinary infection	2(1.0)
Number of anatomical sites involved in lodgment of calculi, %	
One site	174(89.7)
Two sites	20(10.3)
Anatomical site of lodgment of calculi (1), %	
Upper urinary tract	119(61.3)
Lower urinary tract	75(38.7)
Anatomical site of lodgment of calculi (2), %	
Ureter	51(26.3)
Pyelo-ureteric junction	6(3.1)
Pyélo-caliceal	19(9.8)
Others	118(60.8)
Treatment modalities, %	
Conventional surgery	167(86.1)
Ureteroscopy	6(3.1)
Extracorporeal lithotripsy	2(1.0)
Resolved spontaneously	19(9.8)

Table 2. Composition of stones by sites

Types of stones	Sites of stones		All n=194(%)	p
	Upper tract n=119(%)	Lower tract n=75(%)		
Calcium oxalate				<0.001*
Whewellite	94(79.0)	33(44.0)	127(65.5)	
Weddellite	10(8.4)	4(5.3)	14(7.2)	
Phosphates				
carbapatite	10(8.4)	4(5.3)	14(7.2)	
Struvite	0(0.0)	10(13.3)	10(5.2)	
Purines				
Anhydrous uric acid	5(4.2)	17(22.7)	22(11.3)	
Ammonium urate	0(0.0)	6(8.0)	6(3.1)	
Cystine	0(0.0)	1(1.3)	1(0.5)	

*Likelihood-ratio chi-square

Table 3. Size and types of stones by management modalities

Management modalities						
Variables	Surgical n=167	Spontaneous n=19	Ureteroscopie n=6	ESWL n=2	All n=194	p
Large dimension (mm)	24.8±17.1	8.4±3.9	8.3±2.1	13,0±0,0		0.001*
≤20	85(50.9)	17(89.5)	3(50.0)	1(50.0)	106(54.6)	
>20	71(42.5)	0(0.0)	0(0.0)	0(0.0)	71(36.6)	
Fragments	11(6.6)	2(10.5)	3(50.0)	1(50.0)	17(8.8)	
Majority components						0.628
Whewellite	108(65.1)	14(73.7)	4(57.1)	1(50.0)	127(65.5)	
Anhydrous uric acid	19(11.4)	2(10.5)	0(0.0)	1(50.0)	22(11.3)	
carbapatite	12(7.2)	0(0.0)	2(28.6)	0(0.0)	14(7.2)	
Weddellite	10(6.0)	3(15.8)	1(14.3)	0(0.0)	14(7.2)	
Struvite	10(6.0)	0(0.0)	0(0.0)	0(0.0)	10(5.2)	
Ammonium urate	6(3.6)	0(0.0)	0(0.0)	0(0.0)	6(3.1)	
Cystine	1(0.6)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	

*Likelihood-ratio chi-square

Supplementary Files

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