Scientific Research Publishing

Open Journal of Urology, 2022, 12, 276-285
https://www.scirp.org/journal/oju
ISSN Online: 2160-5629
ISSN Print: 2160-5440

Endoscopic Management of Bladder Stones: Initial Experience at a Single Center in Cameroon

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How to cite this paper: Kamadjou, C., Kameni, A., Moby, H., Kolela, D.B., Mbassi, A. and Angwafor, F. (2022) Endoscopic Management of Bladder Stones: Initial Experience at a Single Center in Cameroon. *Open Journal of Urology*, **12**, 276-285.
https://doi.org/10.4236/oju.2022.125028

Received: January 15, 2022
Accepted: May 24, 2022
Published: May 27, 2022

Abstract

Purpose: This study aimed to evaluate the efficacy and safety of endoscopic lithotripsy with the lithoclast (EMS, Switzerland) and laser Holmium YAG in the management of bladder calculi. **Materials and methods**: This was a retrospective study carried out from January 2013 to December 2019 on 32 patients with bladder calculi. All the patients underwent either Lithoclast or Laser lithotripsy using a 22F Storz cystoscope at the *Centre medico-chirugicale d'urologie* in Douala, Cameroon. Data on patients' ages, clinical symptoms, stone sizes, type of lithotripsy, surgery duration, and results of lithotripsy were collected and analyzed using Epi info 7. **Results:** We recruited 32 participants (24 men and 8 women) with a median age of 41.28 [22 - 68] years into this study. In 9 (28.12%) participants, macroscopic hematuria was the main presenting complaint, followed by lower urinary tract symptoms in 8 (25%) patients. A cystoscopy was performed in 17 (53.12%) patients to confirm the diagnosis of a bladder stone, and ultrasonography of the upper urinary tract was performed in 29 (90.6%) cases to certify the absence of another stone. Lithoclast EMS was used to manage the stones in 23 (71.87%) patients while laser lithotripsy was used in 9 (28.13%). A dormia basket was used to remove stone fragments in 10 (31.25%) patients. The mean surgery duration was 33.59 ± 14.2 minutes, and the bladder stones were successfully managed in all the participants of this study. Minor complications such as pain during micturition were found in 28 (87.37%) patients, with complete resolution occurring two weeks after surgery. **Conclusion**: Endoscopy with lithotripsy is

a safe and effective method of management of bladder stones. This technique is also associated with short surgical procedures and postoperative hospitalization periods. We believe that it is an excellent treatment modality in the management of bladder stones.

Keywords

Bladder Stone, Lithotripsy, Mini-Invasive Surgery, Dormia Basket

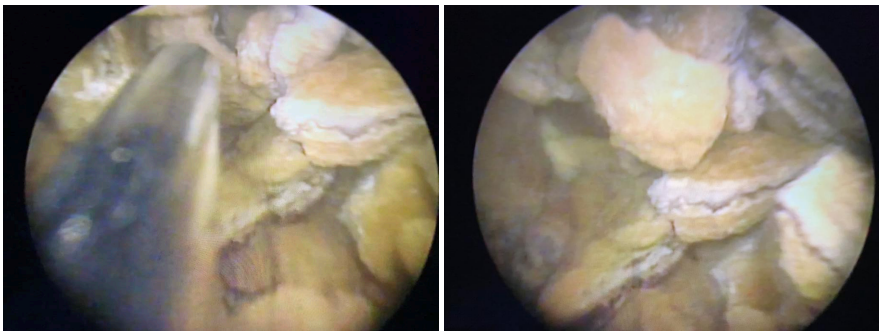
1. Introduction

The urinary bladder is a sac-like organ located in the pelvic cavity. The main function of this organ is to collect and store urine before its expulsion via micturition. The bladder, like other organs in the urinary tract, can be a location for urinary stones (calculi). These calculi develop when the minerals in urine crystalize to form stones. The minerals in question include urate, calcium oxalate, calcium phosphate, ammonium urate, cystine, and calcium-ammonium-magnesium phosphate [1]. In the literature, bladder stones are usually studied within the framework of urolithiasis and not as a separate entity. It has been reported that males are generally more predisposed to urinary stones than females [2]. Hence, as expected, the prevalence of bladder stones has also been reported to be higher in males than in females [3]. Bladder stones represent 5% of all urinary stones [4], and their clinical presentation is highly variable, ranging from being asymptomatic in some cases to having symptoms such as terminal macroscopic hematuria, suprapubic pain, recurrent infections, and irritable symptoms [5]. A CT image of a bladder stone is presented in **Figure 1**.

Bladder urolithiasis is mainly caused by urinary stasis, such as that due to benign prostatic hypertrophy or a neurogenic bladder. Foreign bodies that are left in the bladder and are not spontaneously expelled would eventually form layers of stone material and develop into bladder stones. In 36.7% of cases, bladder stones are associated with previous kidney stone disease [6]. The management of bladder stones depends on the clinical presentation and severity of the patient's symptoms. It ranges from conservative medical treatment to open surgery. It is important to manage large renal, ureteric, and bladder calculi in time because they could lead to more redoubtable medical conditions in the long run. Diniz *et al.* reported a case of renal failure due to a giant bladder stone in 2017 [7]. Medical treatment includes hyperhydration, non-steroidal anti-inflammatory drugs, and opioids in the case of refractory pain. Medical expulsive therapy (MET), which includes alpha-blockers such as doxazosin and tamsulosin, is sometimes used. Severe cases with large stones are managed surgically [8]. With recent advancements in technology, open surgery is gradually being replaced by mini-invasive procedures in the management of urolithiasis. Mini-invasive procedures have the advantages of being esthetic, being associated with shorter hos-

pitalization periods, having fewer complications, and being associated with less blood loss during the intervention, and having higher stone clearance rates than open surgery [9]. Currently, mini-invasive treatment options include extracorporeal shock wave lithotripsy (ESWL) and laparoscopic ureterolithotomy [10]. For bladder stones, mini-invasive lithotripsy techniques include transurethral cystolithotripsy (TUCL) and percutaneous cystolithotripsy (PCCL). According to current evidence, TUCL is the treatment of choice for bladder stones in adults and children [4]. As is the case with ureteral stones, lithotripsy of bladder stones can be performed either with the laser holmium YAG or the lithoclast (EMS, Switzerland) [11]. The long-term efficacy of mini-invasive techniques such as extracorporeal shockwave lithotripsy has been demonstrated in previous studies [12]. These techniques have also been demonstrated to have no significant adverse effects in the long term [13]. However, there is a paucity of studies comparing the results obtained using these two pieces of equipment in the management of bladder stones. The endoscopic view of a fragmented bladder stone during lithotripsy is presented in **Figure 2**.

Figure 1. Bladder stone on CT scan.



(a) (b)

Figure 2. Fragmentation of a stone using a lithoclast during surgery. (a) Lithoclast fragmenting the stone; (b) Fragments of the stone.

2. Materials and Methods

This is a retrospective study carried out from January 2013 to December 2019 at the *Centre medico-chirugicale d' urologie* in Douala, Cameroon. We included all patients with bladder stones who were diagnosed and managed at our center via either lithoclast or laser cystolithotripsy using a 22F Storz cystoscope and excluded patients whose files were missing some important information. We collected data from the clinical records of 32 patients with bladder calculi. The data collected for each patient included the age, sex, initial clinical presentation (which included lower urinary tract symptoms, recurrent urinary tract infections (two cases of infection with *E. coli* and one case each of infection with *Klebsiella pneumonaie*, *Staphylococcus saprophyticus*, and *Proteus mirabilis*), macroscopic hematuria, hypogastric pain, irritative symptoms, and acute urinary retention), diagnostic tool used, size of the bladder stone, duration of the surgical intervention, type of anesthesia used (locoregional anesthesia or general anesthesia), duration of hospitalization in days, postoperative complications, use of the dormia basket, and the outcome of the intervention. According to a previous study [14], we classified the bladder stones into small stones (<30 mm) and large stones (≥30 mm). These data were recorded in Microsoft Excel 2016 and later exported to Epi info 7 for analysis. Continuous variables were presented as mean values and standard deviations for normally distributed data and as median values with interquartile ranges for data with skewed distributions. Categorical variables were presented as frequencies and percentages. The Mann-Whitney U test and the independent-sample t-test were used to compare continuous variables for skewed and normally distributed data, respectively. The Chi-square test and Fisher's exact test were used to compare categorical variables. Values of $p < 0.05$ were considered statistically significant. This study was approved by the institutional review board of the Faculty of Medicine and Pharmaceutical Sciences of the University of Douala and by the ethics committee of the *Centre medico-chirugicale d'urologie* in Douala. The requirement for patients' informed consent was waived due to the retrospective nature of the study.

3. Results

We recruited a total of 32 patients into this study. Twenty-three (71.88%) of our participants underwent lithoclast lithotripsy and nine (28.12%) underwent laser holmium lithotripsy. The ages of our patients ranged from 22 years to 68 years, with a mean value of 41.28 ± 13.99 years. The patients who underwent lithoclast lithotripsy (45.83 ± 13.61 years) were significantly older than those who underwent laser holmium lithotripsy (29.67 ± 6.12 years) ($p = 0.002$). There were 24 (75%) men and 8 (25%) women in this study; however, the difference in gender distributions between the two groups was not statistically significant. Concerning the clinical presentations of the participants, the most common clinical presentation was macroscopic hematuria, which was manifested in 9 (28.13%)

participants. All participants with lower urinary tract symptoms, recurrent urinary tract infections, and acute urinary retention underwent lithoclast lithotripsy. Among the nine participants that underwent laser holmium lithotripsy, 6 (66.67%) presented with macroscopic hematuria, 1 (11.11%) presented with hypogastric pain, while 2 (22.22%) presented with irritative symptoms (Table 1).

The diameters of the stones ranged from 8 mm to 37 mm with a mean value of 19.09 ± 7.65 mm. There were 28 (87.5%) small stones and 4 (12.5%) large stones. All the patients who underwent laser holmium lithotripsy had small stones. There was no significant difference in the proportion of small and large stones between the two groups. The sizes of the stones of patients who underwent lithoclast lithotripsy ranged from 15 mm to 37 mm, with a mean value of 22.52 ± 6.14 mm, while those of patients who underwent laser holmium lithotripsy ranged from 8 mm to 13 mm, with a mean value of 10.33 ± 1.66 mm. The bladder stones in patients that underwent lithoclast lithotripsy were significantly bigger than those in patients that underwent laser holmium lithotripsy ($p < 0.001$). The positive diagnosis of these stones was done through cystoscopy in 17 (53.13%) cases, via ultrasound in 12 (37.5%) cases, and via antero-posterior tomodensitometry in 3 (9.38%) cases. Regarding the etiologies of the stones, there was no obvious etiology in 14 (43.75%) cases, the etiology was benign prostatic hypertrophy in 11 (34.38%) cases, non-resorbable sutures for vesicovaginal fistulas in two (6.25%) cases, calcified double-J stents in 3 (9.38%) cases, a neurogenic bladder and the presence of a prolapsed intrauterine contraceptive device in one case (3.13%) each (Table 2).

The surgery duration ranged from 15 minutes to 65 minutes, with a mean value of 33.59 ± 14.2 minutes. The mean duration of lithoclast lithotripsy was significantly higher than that of laser holmium lithotripsy. Lithotripsy was carried out under locoregional anesthesia in 29 (90.62%) cases and under general anesthesia in 3 (9.38%) cases. All cases of laser holmium lithotripsy were carried out under locoregional anesthesia. The duration of hospitalization ranged from 1 - 4 days with an average value of 1.219 days. There was no significant difference in the duration of hospitalization between the two techniques. There were no major postoperative complications except for two patients who experienced fever after undergoing lithoclast lithotripsy. Twenty-seven of the 32 study participants experienced painful micturition as a minor postoperative complication while five participants who underwent lithoclast lithotripsy did not experience any minor postoperative complication. However, this symptom completely was no longer present in all the participants who experienced it during their follow-up appointment that took place 15 days after the procedure. Ultrasound was used as the follow-up postoperative imaging method in 29 of the 32 study participants while anteroposterior tomodensitometry was used in three patients whose bladder stones resulted from calcified double-J stents. Dormia baskets were used in 10 (31.25%) participants but not used in 22 (68.75%) participants. There was a significant difference in the rate of use of the dormie basket between

the two groups. All the participants of this study survived the intervention (Table 3).

Table 1. Characteristics of the patients.

Parameter	Lithoclast	Laser Holmium	Total	p-value
Mean age	45.83 ± 13.61	29.67 ± 6.12	41.28 ± 13.99	**0.002**
Sex				
Males	17 (70.83%)	7 (29.17%)	24 (75%)	0.60
Females	6 (75%)	2 (25%)	8 (25%)	
Presentation				
Lower UT symptoms	8 (34.87%)	0 (0%)	8 (25%)	-
Recurrent UTIs	5 (27.74%)	0 (0%)	5 (15.63%)	-
Hematuria	3 (13.04%)	6 (66.67%)	9 (28.13%)	**0.005**
Hypogastric pain	2 (8.7%)	1 (11.11%)	3 (9.38%)	0.64
Irritative symptoms	1 (4.35%)	2 (22.22%)	3 (9.38%)	0.18
Acute urinary retention	4 (17.39%)	0 (0%)	4 (12.5%)	

*UT: Urinary tract; URI: Urinary tract infection.

Table 2. Characteristics of the stones.

Parameter	Lithoclast	Laser Holmium	Total	p-value
Mean diameter	22.52 ± 6.14	10.33 ± 1.66	19.09 ± 7.65	<**0.001**
Small stone (<30 mm)	19 (82.61%)	9 (100%)	28 (87.5%)	0.25
Large stone (≥30 mm)	4 (17.39%)	0 (0%)	4 (12.5%)	
Diagnosis				
Cystoscopy	11 (47.83%)	6 (66.67%)	17 (53.13%)	0.29
Ultrasound	9 (39.13%)	3 (33.33%)	12 (37.5%)	0.55
AP TDM	3 (13.04)	0 (0%)	3 (9.38%)	-
Etiologies of stones				
None obvious	5 (21.74%)	9 (100%)	14 (43.75%)	<**0.001**
BPH	11 (47.83%)	0 (0%)	11 (34.38%)	-
VVF suture	2 (8.7%)	0 (0%)	2 (6.25%)	-
Calcified JJ stent	3 (13.04%)	0 (0%)	3 (9.38%)	-
Neurogenic Bladder	1 (4.35%)	0 (0%)	1 (3.13%)	-
Prolapsed IUCD	1 (4.35%)	0 (0%)	1 (3.13%)	

*BPH: Benign prostatic hypertrophy; IUCD: Intrauterine contraceptive device; VVF: Vesicovaginal fistula; JJ stent: Double-J stent; AP TDM: Anteroposterior tomodensitometry.

Table 3. Characteristics of the lithotripsy.

Parameter	Lithoclast	Laser Holmium	Total	p-value
Surgery duration	37.83 ± 14.51	22.78 ± 4.41	33.59 ± 14.2	**0.005**
Hospitalization duration	1.219	1.3	1	0.25
Type of Anesthesia				
Locoregional	20 (86.96%)	9 (100%)	29 (90.62%)	0.36
General	3 (13.04%)	0 (0%)	3 (9.38%)	
Major post-op complications				
None	21 (91.30%)	9 (100%)	30 (93.75%)	0.51
Fever	2 (8.70%)	0 (0%)	2 (6.25%)	
Minor post-op complications				
None	5 (21.74%)	0 (0%)	5 (15.63%)	0.17
Painful micturition	18 (78.26%)	9 (100%)	27 (84.37%)	
Follow-up imaging				
Ultrasound	20 (86.96%)	9 (100%)	29 (90.62%)	0.36
AP TDM	3 (13.04%)	0 (0%)	3 (9.38%)	
Use of the dormia basket				
Yes	10 (43.48%)	0 (0%)	10 (31.25%)	**0.018**
No	13 (56.52%)	9 (100%)	22 (68.75%)	

*AP TDM: Anteroposterior tomodensitometry.

4. Discussion

This study aimed to evaluate the efficacy and safety of endoscopic lithotripsy with the lithoclast (EMS, Switzerland) and laser Holmium YAG in the management of bladder calculi. The mean age of our study participants was 41.28 ± 13.99 years, which is higher than the mean age of 13 years reported by Esposito *et al.* in 2021 [15] but lower than the 54.70 ± 9.80 years reported by Gong *et al.* in the same year [14]. This difference in age is mainly because Esposito *et al.* carried out their study in children and Gong *et al.* carried out theirs in older adults who were predisposed to bladder outlet obstruction issues such as prostatic hypertrophy while we studied young adults. There were 24 (75%) men and 8 (25%) women in our study, which is in line with a report stating that the incidence of stones in men is more than twice that in women [16]. A 15:1 male-to-female ratio was also reported by Karami *et al.* in 2016 [17]. In our study, macroscopic hematuria (28.13%) and acute urinary retention (12.5%) were among the main clinical presentations. This is in line with the report presented by Toricelli *et al.* in 2017 [18], as they reported macroscopic hematuria and acute urinary retention as the two main clinical findings in their 65-year-old patient. Other clinical presentations we enlisted, including lower urinary tract symptoms (25%) and bladder irritative symptoms (9.38%), which were also re-

ported by Chong *et al.* in 2021 [14], while pain was reported by Hammad *et al.* in 2006 [19]. As concerns the etiologies of the bladder stones, we reported no obvious etiology in 43.75% of cases, BPH in 34.38% of cases, VVF sutures in 6.25% of cases, calcified double-J stents in 9.38% of cases, prolapsed IUCDs in 3.13% of cases, and a neurogenic bladder in 3.13% of cases. As can be observed, all our obvious etiologies classify as bladder outlet obstruction, which is in line with the findings of the study by Douenias *et al.* who reported bladder outlet obstruction as the main cause of bladder stones [20]. As stated earlier, the bladder stones were managed either via lithoclast lithotripsy or laser holmium lithotripsy. The surgery duration was significantly longer in the lithoclast lithotripsy group than in the laser holmium lithotripsy group, which is in line with the results of the study carried out by Jeon *et al.* in 2005 [11]. However, unlike Jeon *et al.*, we found no significant difference in the duration of hospitalization between the two groups. This is probably because unlike Jeon *et al.* who recruited a similar number of participants in both groups, one of the groups in our study is made of 23 participants while the other is made of just 9 participants. Sajid *et al.* also reported a significantly shorter surgery duration with laser holmium lithotripsy than with lithoclast lithotripsy in 2021 [21]. All the 9 patients who underwent laser holmium lithotripsy did so under locoregional anesthesia, which is in line with the findings of Cicione *et al.* in 2018 [22]. As stated earlier, the only major postoperative complication reported among our study participants was fever, and no case of fever was reported in the laser holmium group. This is in line with the findings of Tipu *et al.* in 2007, who concluded that laser holmium lithotripsy was a superior technique to pneumatic lithoclast lithotripsy in terms of stone clearance and complications [23]. The age of the patients in the lithoclast lithotripsy group was significantly higher than that in the laser holmium lithotripsy group, which is also in line with the findings of Tipu *et al.* The mean stone size of the lithoclast lithotripsy group was significantly higher than that of the laser holmium lithotripsy group, which is contrary to the findings of previous studies [23] [24]. In this study, the stone clearance rate was 100% for both procedures, which is contrary to the findings of previous studies which report a higher stone clearance rate for laser holmium lithotripsy than for lithoclast lithotripsy [23] [24]. This is probably due to the fact that we recruited fewer participants and went further to use a dormia basket to extract stone fragments in certain cases to ensure a 100% stone clearance rate.

5. Conclusion

Both lithoclast lithotripsy and laser holmium lithotripsy are efficient in the management of bladder stones. However, laser holmium lithotripsy offers the additional advantage of a shorter surgery duration and significantly fewer postoperative complications.

Acknowledgements

The authors thank Health Search Association for their contribution to this work.

Funding

The authors did not receive any external funding for this study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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