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Original Artide

Ureteroscopy and Holmium:YAG Laser Lithotripsy For Upper Tract Stones in a New Urology Centre: Our Initial Experience

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Abstract

Background: To demonstrate the outcome of our initial experience in the management of upper tract stones with ureteroscopy and Holmium: YAG laser lithotripsy.

Methodology: The data of thirty-two patients who had ureteroscopy and laser lithotripsy for upper urinary tract stones at a private urology centre in Awka, Anambra State Nigeria from September 2020 to June 2022 (20months) were retrospectively studied. Their sociodemographic data, clinical symptoms, the location and size of the stones, preoperative and postoperative stent use, hospital stay, complications, and stone-clearance rates were analyzed.

Results: A total of 32 procedures were performed on 32 patients. The mean age of the patients was 44.7 ± 12.2 years. The mean stone size was 15.4 ± 6.7mm with a range of 8.0-39mm, and Hounsfield unit ranging from 233-906. The stones were on the right tract, left tract, and bilateral in 46.9%, 43.7%, and 9.4% of the cases respectively. The patients had a mean length of hospital stay of 3.31 ± 1.45 days. The stone clearance rate was 90.3%. 53.1% of the patients had postoperative complications with 40.6% of these being post-operative fever which resolved with antibiotics. There was treatment failure in one patient due to the inability to scope the ureter on account of ureteral stricture.

Conclusion: Ureteroscopy and laser lithotripsy are safe and effective options in the management of upper tract stones with the advantages of being performed via a natural orifice, being less painful, with reduced risk of severe bleeding, irreversible loss of renal parenchyma, as well as a short hospital stay.

Keywords: Kidney; Ureter; Stones; Ureteroscopy; Holmium laser; Lithotripsy.

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Introduction

Urolithiasis is a common urological disease worldwide with attendant morbidity like flank pain, recurrent urinary tract infection, haematuria and renal failure.[1] Global prevalence is estimated to be about 1-5%, while prevalence in developed and developing nations are estimated to be 2-13% and 0.5-1% respectively.[2] Though the incidence rate of urolithiasis is perceived to be low in Africa, particularly due to poor record keeping, recent data suggest it is at par with what obtains in the western world, particularly as more and more people conform to Western dietary habits and to sedentary lifestyles.[3] The rising temperature patterns, as well as increased availability of modern diagnostic facilities and trained urologists have also increased the diagnosis of this pathology.[4,5]

A wide range of options exist for the management of upper tract stones, and these include watchful waiting, medical expulsion therapy, extracorporeal shockwave lithotripsy, flexible and semi-rigid ureterorenoscopy, percutaneous nephrolithotomy, laparoscopic ureterolithotomy, open nephrolithotomy, pyelolithotomy, ureterolithtomy, and nephrectomy. The choice of treatment modality depends on the size, site and composition of the stone, available equipment, patient's preference, expertise of the surgeon, the residual function of the affected kidney and that of the contralateral kidney.[5] In Nigeria, most centers still offer open surgeries for upper tract stones, owing largely to the lack of endoscopic equipment and expertise in endourology. However, the trend appears to be changing, as some private health facilities are beginning to acquire equipment and expertise for uroendoscopic surgery.

Ureteroscopic laser lithotripsy has emerged as one of the most common approaches used in the minimally invasive treatment of upper tract stones due to its safety and effectiveness.[6]Its ability to access the upper tract collecting system, associated with the development of a safe, reliable, and flexible endoscopic lithotripsy source, combined with more efficient extraction instruments, has made the flexible ureteroscopic laser lithotripsy more attractive to effectively treat renal and ureteral stones with high success rates and low morbidity.[7] Although, it is generally used for kidney stones smaller than 2 cm, it is currently preferred by some surgeons for patients with a greater stone load.[8] It has the advantage of being performed via a natural orifice, being less painful, with reduced risk of severe bleeding and irreversible loss of renal parenchyma. It is also associated with short length of hospital stay and little or no restriction to physical activity.[8] It is also suitable for treatment of upper tract stones in pregnant and obese patients.[9] Although, it is generally a safe procedure, it can be complicated with mucosal ureteric injury, post-operative fever, urosepsis, haematuria, ureteral avulsion, ureteral stricture and persistent vesicoureteric reflux.[10]There is the risk of stone retropulsion into the kidney during treatment. The use of ureteral stents also comes with its attendant morbidity.[9] There is also the limitation of high cost of the instrument and its maintenance, and need for long learning curve.[11]

We present our initial experience with ureteroscopic laser lithotripsy for the management of upper tract stones in Nigeria.

Patients and Method

This is a retrospective study of all upper urinary tract stones (kidney to ureterovesical junction) done at Royal Care Specialist Hospital and Urology center in Awka Anambra State from September 2020 to June 2022 (20months).

All the patients were thoroughly assessed and had full blood count, serum electrolyte urea and creatinine, urinalysis, urine microscopy culture and sensitivity and where indicated, a chest X-ray and Echocardiography. Most patients had computerized tomography (CT) urography, noting the stone location, size, Hounsfield unit and urinary tract configuration, while others had intravenous urography (IVU). For middle and lower ureteric stones, semi-rigid ureteroscopy (URS) and laser lithotripsy was done while for renal and upper third ureteric stones, flexible ureteroscopy (FURS) and laser lithotripsy was done. All our patients had general anaesthesia with muscle relaxation. Patients who had pneumatic lithotripsy for lower ureteric stones were excluded.

Procedure Technique: For the URS, it was done after cystoscopy and identification of the ureteric orifice (UO) of the affected side. A 0.035", 150cm length Terumo glide wire was passed with the help of a 6Fr ureteric catheter to the kidney or until it hits a resistance. The guide wire was taped to the patient's thigh as a safety guide wire and the cystoscope is removed. A size 10 silastic foley catheter is passed for bladder decompression during the procedure and a size 6.5/7F, 6º Karl Storz semi-rigid URS passed with a second guide wire up to the level of the stone. Where the initial guide did not pass around an impacted stone, a glide wire was usually passed around the stone under URS vision. The stone was then dusted with Holmium: Yttrium-Aluminum-Garnet (Ho:YAG, holmium) laser (35Wat Litho Quanta LASER) with fiber size 272micron.

For renal and upper third ureteric stone, after cystoscopy and identification of the affected UO, a 0.035", 150cm length Terumo glide wire was passed with the help of a 6Fr ureteric catheter and left in place. A semi-rigid URS with a second 0.032" super stiff guide wire (Zebra) was passed (riding on rail) to inspect the ureter up to the stone or calyces. The super stiff guide wire was then placed under URS vision at the upper pole of the kidney and the semi-rigid URS and first glide wire removed. If the UO was adjudged pliable, a Cook Medical hydrophilic coated ureteral access sheet (UAS) size 10.7/12.7Fr was passed under fluoroscopic guidance up to just below the pelvi-ureteric junction. A size 10F silastic catheter was then passed into the bladder to aid decompression during the procedure. If not pliable, a 5Fr double-J stent was passed for passive dilatation for 2 weeks. A digital flexible URS size 8.4Fr (MEDIC AFRIC) was then passed via the UAS and the pelvicalyceal system inspected for pathology and stones. The stone was dusted with Ho:YAG laser as above. An N-gage basket was used to aid retrieval of stone fragments, or to relocate stones to middle or upper calyces where they can be dusted effectively.

Irrigation was done with Normal saline under gravity and aided with a manual pump (pathfinder) when necessary.

After the procedure, a size 5Fr double-J stent was passed under fluoroscopic guidance and urethral catheter left in situ until post-procedural haematuria clears, which in most cases was within 24hrs. Stents were usually removed at 4 weeks.

Follow up was, mainly, by clinical assessment of pre-surgery symptom and plain abdominal X-ray prior to stent removal. Patients were adjudged stone free when there was no visible stone on plain abdominal X-ray, and they no longer have the symptoms.

Data was obtained from patients' case files using a proforma onsociodemography, clinical presentation, stone burden, procedural technique, complication, duration of admission, pre- and post-surgery Double J stent placement, comorbidities and need for a secondary procedure were imputed and analyzed using the Statistical Package for the Social Sciences (SPSS) version 22.

Results

A total of thirty-two patients had retrograde ureteroscopy and laser lithotripsy in the period under review, of which 18(56.2%) were men and 14(43.8%) were females, giving a male: female ratio of 1.3: 1. The mean age of the patients is 44.7 ± 12.2years, with a range of 22-71years.

All the patients (100%) presented with flank pain, while 11(34.4%) and 8(25%) had fever and haematuria respectively (table 1). Of the patients, 15(46.9%) of them had red blood cells on urinalysis, 5(15.6%) had trace red blood cells while 12(37.5%) had none. The stone size was 15.4 ± 6.7mm, with a range of 8.0-39.0 mm, and Hounsfield unit ranging from 233-906. See table 2 for the associated comorbidities. The distribution of the stone along the upper tract is as shown in Table 3. The stone was on the right side in 15(46.9%) of the cases, on the left in 14(43.7%) of the cases, while being bilateral in 3(9.4%) of cases. The stone characteristics were assessed with CT scan in 29(90.6%) of the patients while the rest were with IVU.

Table 1: Presenting symptoms

Presenting symptoms	n=32	%
Fever	11	34.4
Haematuria	8	25
Pain	32	100
Passage of stone	2	6.3

Flexible ureteroscope was used in 20(62.5%) patients while a semi-rigid scope was used in 12(37.5%) patients. Only 4(12.5%) patients had preoperative ureteral stenting and surgery postponed allowing for ureteral dilatation while 31(96.9%) had post-operative ureteral stenting. Stone clearance was achieved in 90.3% of our patients. The patients had a mean length of hospital stay of 3.31 ± 1.45days with a range of 1-6days.

Table 2: Distribution of comorbidities

Comorbidity	Frequency n (%)
Hypertension	5 (15.6)
Diabetes	1 (3.1)
Asthma	1 (3.1)

Table 3: Pattern of stones distribution in the upper tract.

Location of stone	n=32	%
Renal upper pole	0	0
Renal middle pole	4	12.5
Renal lower pole	2	6.3
Renal Pelvis	16	50
Upper ureter	1	3.1
Middle ureter	3	9.4
Lower ureter	6	18.8

The complications noted during and after the procedure are noted in Table 4. There was no case of mortality within 30 days of the procedure.

Table 4: Complications after the procedure.

Complications	n=32	%
Total number	17	53.1
Post-op fever	13	40.6
Ureteral perforation	1	3.1
Stent irritation/pain	1	3.1
Steinstrasse	1	3.1
Inability to access stone	1	3.1

Discussion

The surgical management of urinary tract stones has witnessed remarkable refinement over the past few decades, with ureteroscopy and lithotripsy gaining a strong interest and preference among urologist. This owes much to technological advancements in the production of semi-rigid and flexible ureteroscopes as well as the advancement of laser technology. The holmium laser has found one of its greatest application in urological procedures, particularly lithotripsy, due to its precision and strong decomposing power.[12,13]URS and laser lithotripsy offers clear advantages which include low complication rates, less post-operative pain, high stone free rate (SFR), and short length of hospital stay.[9] On account of these, it was recommended by European Association of Urology (EAU) as the first choice for the removal of renal stone <20mm and alternative method for the removal of stone >20mm in patients with contraindications for percutaneous nephrolithotomy.[14]

In our series, we had a mean stone size of 15.4 ± 6.7mm. Though current guidelines recommend percutaneous nephrolithotomy over URS for stone size greater than 20mm, there is still good evidence to use URS for such stones even if it warrants staging the procedure as it makes for better nephron preservation and lower complication rate. [9] One patient who had a stone size of 39mm in our series had a two-staged procedure.

Pre- and post-operative ureteral DJ stenting has a place in ureteroscopy and laser lithotripsy for upper tract stones. Pre-operative DJ stenting is used to passively dilate the ureter to later allow passage of endoscopic equipment or in settings of obstructive uropathy, impending urosepsis or renal failure.[15] Postoperatively DJ stents are indicated in the setting of ureteral injury, as it decreases obstruction from any ensuing ureteral wall edema, while potentially reducing the risk of ureteral stricture.[16] However, use of stent has to be balanced with the risk of significant stent complications like irritative bladder symptoms, dysuria, flank pain and pelvic pain. [17] Only 4(12.5%) patients had preoperative ureteral DJ stenting and surgery postponed allowing for ureteral dilatation while 31(96.9%) had post-operative ureteral DJ stenting. Fortunately, the complaint of severe stent irritation was recorded for only one of our patients. This may have been due to proper counseling on what to expect from stents before the procedure.

We had a stone free rate of 90.3% after single session of the procedure in our series. This is comparable to similar studies done by Hatipoğlu et al.,[18] Fuchs et al.,[19] and Cocuzzaet al.[20]who reported a stone clearance rate of 87%, 86% and 93.1% respectively. A local study by Akpayaket al. [21] on middle and lower ureteric stones only, had a stone free rate of 90.5% which is comparable to ours. They used pneumatic lithotripsy energy source while we used laser energy. Another local study by Alabi et al. [22] also using pneumatic lithotripsy for ureteric stones reported a 100% stone free rate. Of our 3 patients that had residual stones, all were kidney stones. One had a repeat procedure to achieve complete stone clearance and one is symptom-free and does not want further procedure. The third patient finally had a percutaneous nephrolithotomy to achieve complete stone clearance.

Though ureteroscopy and laser lithotripsy is a relatively safe procedure, it may still be associated with complications and failure. [23,24] The overall complication rate reported in the literature is 4.7–9%.[25,26] The reported incidence rate of ureteral perforation is less than 2%.[23]The most dreaded complication is ureteral avulsion injury, which involves a circumferential disruption of ureteral continuity. [9,27] This usually occur during stone fragment extraction with a stone basket. Other minor complications include ureteral perforation, false passage, mucosal abrasions, renal injury, arteriovenous fistula, stone retropulsion, instruments' breakage or malfunctioning, extravasation, bleeding, difficult access and incomplete stone ablation. [27] We had one case of ureteral perforation which did well with procedural ureteral DJ stenting over our insitu safety guide wire. Placement of DJ stent might have been difficult without the safety guide wire in that case which is our routine practice. Other complications we noted included post-operative fever (40.6%), stent irritation (3.1%) and steinstrasse (3.1%). The post operative fever rate is high compared to other studies and most of them happened in our earlier cases.[28] The post operative fever rates dropped as we gained experience. Experience led to reduced operative time and reduced water pressure which are known to reduce infection rate.[28] For the one patient who had treatment failure, we were unable to scope the ureter on account of ureteral stricture. This could have resulted from stone impaction causing long-term irritation of the ureteral wall, thus, causing mucosal edema and inflammation that in turn results in polyps, granulation tissues, as well as ureteral lumen obstruction in severe cases. This may prevent stone visualization and lead to surgical failure.[12] Occasionally, using a smaller-sized scope or doing ureteral balloon dilatation may allow passage over the stricture. The available scopes did not pass, and the patient was counseled for open surgery which she was yet to consent to at the time of this report.

The mean length of hospital stay for our patients was 3.31 ± 1.45 days. This is similar to a work done by Yan et al. [29] which had a mean postoperative hospital stay of 3.1±1.2 days. This short length of hospital stays post-procedure, with a trend towards the procedure being done as a day case procedure, has the benefits of better patient satisfaction, early return to work and less hospital cost. [30,31]

Conclusion

Ureteroscopy and laser lithotripsy is a safe and effective option in the management of upper tract stones with the advantages of being performed via a natural orifice, being less painful, reduced risk of severe bleeding and irreversible loss of renal parenchyma, and short hospital stay. Post operative fever was our commonest complication and reduced with experience.

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