The conservative management of staghorn stone patients

Evaluation of safety and clinical outcomes

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INTRODUCTION

Complex staghorn stones, characterized by their extensive branching structure occupying the renal pelvis and calyces, can lead to severe complications, including recurrent urinary tract infections (UTI) (50%), renal function deterioration (24.5%), and death (30%), if left untreated.[1,2] The standard approach is active surgical intervention to achieve stone clearance.[3] Contemporary data on non-surgical approaches are lacking, with no large-scale studies on this topic over the past three decades.[1,4,5] Given the high rate (30%) of life-threatening complications with percutaneous nephrolithitomy (PCNL) among highly comorbid populations,[6,7] there is a need to reassess management options for these patients.

The purpose of this study is to contribute contemporary data on the safety and efficacy of conservative management for patients with staghorn stones, drawing from our single-center experience.

METHODS

Patient selection and chart review

Following institutional review board approval, a retrospective chart review was conducted on patients with unilateral staghorn stones undergoing conservative management from July 2009 to March 2022. All patients were managed by a single surgeon (SA). Conservative management involved serial imaging, metabolic workup, and antibiotic prophylaxis throughout the followup duration for patients with documented UTIs. Staghorn stones were identified via computed tomography. Patients with renal tuberculosis were excluded.

Background patient data were collected, including age, sex, comorbidities, body mass index (BMI), reasons for conservative management, presenting complaints, and history of previous stone treatment. Charlson comorbidity index (CCI) and Eastern Cooperative Oncology Group (ECOG) performance status scores were calculated to assess baseline comorbidity and function.[8,9]

Data on stone management included duration of followup, stone laterality, presence of a solitary functioning kidney, longest length of the index stone, as well mean change in stone size, type of staghorn stone, and composition if analyzed. Urine cultures and metabolic workup findings, including a 24-hour urine collection offered to all patients, and the details of their individualized medical therapy were recorded.

Primary outcomes were stone-related mortality and progressive renal function deterioration, as defined by a 3.3% or greater yearly decrease in glomerular filtration rate (GFR).[10] Secondary outcomes were stone-related complications, renal function loss, and all-cause mortality.

Statistical analyses

The study was descriptive in nature. This involved the calculation of frequencies for categorical variables and the mean and standard deviation for continuous variables. Data management and statistical tests were done using SPSS v2 (IBM Corp, Armonk, NY, U.S.).

RESULTS

Demographic and clinical characteristics

The study included 24 patients (Table 1). The age at the time of stone detection ranged from 17–79 years, with a mean age of 57.7±18.3 years. Conservative management was allocated for 20 (83%) patients deemed to be at high risk for undergoing surgery and/or anesthesia. Most of the patients were asymptomatic on presentation and their staghorn stones were incidentally identified during imaging (11 patients; 46%). Eight (33%) patients had received extracorporeal shockwave lithotripsy (ESWL) as a prior treatment for their stone, two (8%) underwent ureteroscopy (URS), and seven (29%) underwent a PCNL in the past for other stones.

Table 1. Demographic and clinical characteristics	
Patient characteristic	Mean ± SD/frequency (%)
Age at detection (years)	57.7±18.3
Sex (female)	18 (75%)
BMI	27.9±6.6
Comorbidities	
Diabetes mellitus (I/II)	4 (17%)
Hypertension	11 (46%)
CCI	3.1±2.0
ECOG	2±0.8
Reasons for conservative management	
High risk for surgery/anesthesia	20 (83%)
Refusal	4 (17%)
Presenting complaint	
Incidental	11 (46%)
Pain	7 (29%)
UTI	3 (13%)
Hematuria	1 (4%)
Previous treatment	
ESWL	8 (33%)
URS	2 (8%)
PCNL	7 (29%)

BMI: body mass index; CCI: Charleson comorbidity index; ECOG: Eastern Cooperative Oncology Group; ESWL: extracorporeal shockwave lithotripsy; PCNL: percutaneous nephrolithitomy; SD: standard deviation; URS: ureteroscopy; UTI: urinary tract infection.

Stone management and characteristics

All the patients in this cohort had a unilateral staghorn stones, seven (29%) had a solitary functioning kidney, and 11 (46%) had a complete staghorn (Table 2). The average index stone measured 3±1.6 cm at its longest length and, on average, stones regressed in size by 0.3±1.0 mm throughout the followup. Stone analysis identified calcium oxalate as the most common stone type, with four (17%) patients; however, stone composition data was not available for 15 (63%) of the patients.

The results of the metabolic workup revealed that the most present metabolic disturbance was hypocitruria, found among nine (38%) patients, along with 16 (67%) patients having an acidic urine pH and 14 (58%) having low urine volume. Urine culture was positive in 19 (79%) patients, with *Proteus spp*. found in six

Table 2. Stone management and characteristics	
Characteristic	Mean ± SD/frequency (%)
Followup (years)	8.4 ± 4.3
Unilateral	24 (100%)
Solitary kidney	7 (29%)
Full staghorn stone	11 (46%)
Index stone length (cm)	3±1.6
Δ Stone length (mm)	-0.3±10.0
Stone composition	
Calcium oxalate	4 (17%)
Calcium phosphate	3 (13%)
Carbonate apatite	2 (8%)
Struvite	1 (4%)
Uric acid	1 (4%)
Not known	15 (63%)
Metabolic workup	
Hypercalciuria	4 (17%)
Hypocitruria	9 (38%)
Hyperoxaluria	1 (4%)
Hyperuricosuria	3 (13%)
Acidic pH	16 (67%)
Basic pH	3 (13%)
Low urine volume	14 (58%)
Not done	4 (17%)
Urine culture	
Positive	19 (79%)
Proteus spp.	6 (25%)
E. coli	6 (25%)
Enterococcus spp.	3 (13%)
Pseudomonas spp.	2 (8%)
Klebsiella spp.	2 (8%)
Citrobacter spp.	2 (8%)
Medical treatment	19 (79%)
Prophylactic antibiotics	15 (63%)
Allopurinol	5 (21%)
Thiazide diuretics	4 (17%)
Alkalization agents	9 (38%)

SD: standard deviation.

(25%) patients and *E. coli* in six (25%) being the most frequently cultured organisms. Nineteen (79%) patients received medical treatment, including prophylactic antibiotics in 15 (63%) patients. The patients were followed for an average period of 8.4 years since the beginning of their treatment.

Patient outcomes

The GFR decreased an average of 1.78 mL/min/1.73 m^2 per year (Table 3). Available data from eight patients revealed an average decrease in differential renal scan function of 0.3±0.86%. Three (13%) patients experienced progressive renal function deterioration, and one patient (4%) required dialysis. Three (13%) patients died during the observed period, none attributable to stone-related complications; two patients died from advanced cancer, and one patient died due to the progression of muscular dystrophy.

DISCUSSION

PCNL has been the standard of care in patients with staghorn stones following Blandy et al's seminal paper in 1973 that showed higher mortality rates in conservatively managed patients (28% vs. 7.2% for open pyelolithotomy);[11] however, there is a paucity of contemporary studies of an active surveillance strategy with medical therapy. Our study's cohort, with an average 8.4-year followup, had zero stone-related mortality and the lowest documented incidence of progressive renal deterioration at 13%.[4,5] Our patients had a survival rate of 87% over a 8.4-year average followup period, which is comparable to their expected survival rate of 77% over a 10-year period based on the group's average CCI score.[8] This may be attributable to our judicious patient selection, close monitoring of patients, and use of medical therapy, although our cohort size limits our ability to statistically test this hypothesis.

Alsawi et al conducted a comprehensive review in 2019, where they found the progressive renal deterioration rate to be 19.4% among conservatively managed staghorn stone patients.[1] They noted that unilateral stone patients retained their renal function better than those with bilateral stones, highlighting the importance of proper patient selection for a conservative approach. Deutsch et al achieved a similarly low rate of renal deterioration (13.6%) to us (13%), also favoring an approach using prophylactic antibiotics for high-risk patients.[4] These findings underscore the trend towards improvement outcomes with judicious patient selection and active medical therapy.

Table 3. Patient outcomes throughout episode of care

Outcome	Mean ± SD/frequency (%)
Δ GFR/year (mL/min/1.73 m^2 per year)	-1.8±2.4
Δ differential function of affected kidney (%)	- 0.3±8.7
RTA	0 (0%)
XGP	1 (4%)
UTI	19 (79%)
Recurrent UTI	16 (67%)
Pyelonephritis	5 (21%)
Urosepsis	3 (13%)
Renal deterioration	3 (13%)
Dialysis	1 (4%)
Hematuria	6 (25%)
Mortality	3 (13%)
Disease-specific mortality	0 (0%)

GFR: glomerular filtration rate; RTA: renal tubular acidosis; SD: standard deviation; UTI: urinary tract infection; XTP: xanthogranulomatous pyelonephritis.

The findings from our paper support the notion of a population-level shift in staghorn stone composition from infectious to metabolic types.[12-14] Only 10 of 24 (41.7%) patients in our cohort grew urease-producing bacteria (*Proteus spp., Pseudomonas spp., Klebsiella spp.*) on urine culture, and a mere 3/9 (33.3%) patients with known stone composition had struvite or calcium carbonate apatitite. Work by Iqbal et al revealed that metabolic abnormalities are found among staghorn stone patients at high rates, irrespective of stone type, further adding to the value of a comprehensive metabolic workup when assessing these patients.[15] This shift towards metabolic stones, which may be a result of population-level changes in diet and obesity rates, supports the viability of an approach using medical therapy to limit stone formation.

Our retrospective study's strengths include having the lengthiest average followup period within the contemporary literature on staghorn stone patients managed non-operatively, a low rate of progressive renal deterioration, and zero stone-related mortality. Limitations in our study include a small patent cohort due to strict selection criteria for conservative management, which in turn, limits our ability to statistically test for associations between variables.

CONCLUSIONS

Our study supports the viability of conservative management, involving adjuvant medical treatment along with watchful waiting as a suitable alternative to surgery for select patients with staghorn stones; however, the decision-making process should be individualized for each patient. Future studies looking into comparing high-risk patients undergoing PCNL vs. an active surveillance strategy with a medical therapy approach would be necessary to further establish the value of these approaches in a contemporary era.

COMPETING INTERESTS: The authors do not report any competing personal or financial interests related to this work.

This paper has been peer reviewed.

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