

The Clinical Outcomes of Conservative Management of Staghorn Calculi from 2011 - 2020: A Single-Center Retrospective Study

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How to cite this paper: Mañacap, M.A.D., Maguad, R.A., Darunday, G.P. and Polito, E. (2026) The Clinical Outcomes of Conservative Management of Staghorn Calculi from 2011 - 2020: A Single-Center Retrospective Study. *Open Journal of Nephrology*, 16, 399-416.

<https://doi.org/10.4236/ojneph.2026.163034>

Received: May 15, 2026

Accepted: August 3, 2026

Published: August 6, 2026

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Abstract

Introduction: Staghorn calculi remain a large challenge due to its risk of renal deterioration, association with life-threatening sepsis, and complexity of its treatment. Its occurrence is of particular importance because it often carries high morbidity and mortality rates. Untreated stones can lead to urosepsis, recurrent urinary tract infections, renal decline, and death. Surgical intervention has always been the mainstay of treatment of staghorn calculi portraying higher survival rates as compared to conservative management. However, there are patients who had conservative management, who survived and even showed improvement of their estimated glomerular filtration rate, signifying that this intervention is not as unsafe as it was previously perceived to be. **Objectives:** This study aims to investigate the clinical outcomes of conservative management of patients with staghorn calculi. **Methods:** This is a single-center, retrospective study of 40 enrolled patients admitted at Perpetual Succour Hospital, Cebu City, from January 1, 2011 to December 31, 2020. Patients who are 18 years old and above, with or without co-morbidities, admitted, and diagnosed with unilateral or bilateral staghorn calculi via computed tomography scan, ultrasound, or intravenous pyelography were included; while patients who are below 18 years old, with lithiasis other than staghorn calculi, end-stage renal disease, and terminally ill were excluded from the study. Data was collected through chart review to answer the general and specific objectives. The patients enrolled were followed-up through a call to evaluate clinical outcomes. A chi-square test was utilized to determine the association of categorical factors and the clinical outcomes of patients with staghorn calculi managed conservatively. **Results:** Forty patients qualified for the study. Most of the patients were elderly or aged more than 60 years old (40%), predominantly female (60%), and mostly dependents (55%). They are all Filipino (100%) and mostly fall under the healthy weight class with a BMI of 18.5 to < 25 cm (37.5%).

Most of them were hypertensive (57.5%) and diabetic (30%), and they also had a family history of hypertension (47.5%) and diabetes mellitus (37.5%) mostly. They were predominantly non-smokers (80%), non-alcoholic beverage drinkers (72.5%), and had no history of illicit drug use (100%). On admission, most patients had an eGFR of 30 - 44 (25%) followed by an eGFR of 60 - 89 (22.5%). The most common signs and symptoms presented were flank pain (35%) and fever (30%). Most of them had a unilateral staghorn calculi on the right (47.5%) with a size of 2 to < 5 cm (42.5%). They were mostly deemed unfit for surgical intervention (82.5%) with the reason most commonly due to an ongoing urinary tract infection (35%) and some having sepsis/septic shock (32.5%). For the conservative treatment, most of the patients received antibiotics (90%), followed by hydration (75%) then urine alkalinizers (62.5%). Out of the 40 patients who received conservative treatment, only 3 patients or 7.5% had a stone-related mortality. Meanwhile, 57.5% had UTI/Recurrent UTI and 15% succumb to renal deterioration requiring dialysis. **Conclusion:** This study concludes that the conservative management of patients with staghorn calculi in Perpetual Succour Hospital presented with a low stone-related mortality (7.5%), with most of the patients having a urinary tract infection/recurrent urinary tract infection (57.5%), and only a few of the population (15%) succumbed to renal deterioration requiring dialysis. This type of intervention can be done especially in select patients.

Keywords

Clinical Outcome, Staghorn Calculus, Conservative Management, Nephrology, Urology, Nephrolithiasis, Kidney Stone, Medical Treatment, Morbidity, Mortality, Renal Function, Active Surveillance, Non-Operative

1. Introduction

Struvite stones also known as *infection stones* or *triple phosphate stones* can grow rapidly to a large size, reduce renal function in the affected kidney, and are difficult to eradicate. Struvite calculi account for up to 30% of urinary tract stones. Most staghorn calculi are composed of struvite and approximately 75% are composed of a struvite-carbonate apatite matrix. Its formation requires the presence of a urease-producing bacteria.

Staghorn calculi remain a challenge due to its risk of renal deterioration, association with life-threatening sepsis, and complexity of its treatment. It represents 10% - 20% of all nephrolithiasis cases. Men are known to be more prone to stone formation than women. However, staghorn calculus is more frequently reported in women and usually unilateral. The occurrence of staghorn calculi is of particular importance because it often carries high morbidity and mortality rates. Untreated stones can lead to urosepsis, recurrent urinary tract infections, renal decline, and death.

Since the 1970s, the mainstay of treatment of staghorn calculi is surgical inter-

vention. Studies have shown that patients fare better with surgery as compared to conservative management. They portrayed a lower survival rate in patients who were treated conservatively as compared to those who underwent surgical treatment. Literature on the sequelae of conservative management is limited. Previous studies have shown that conservative therapy led to high rates of nephrectomy and an increase in associated morbidity and mortality. The most common causes of death are urosepsis and chronic renal failure which reported a mortality rate ranging from 9% - 47%. However, there were also studies, though small and only a few, that concluded that conservative management could be safe in select patients with appropriate monitoring. This information is critical to the decision-making process for patients with high surgical risk and poor reserve.

This study would like to add data regarding the outcome of conservative management of staghorn calculi. We will review our institutional experience over 10 years to describe the clinical profiles, kidney function patterns and overall outcomes of patients with staghorn calculi that were managed non-surgically.

2. Review of Related Literature

Nephrolithiasis are common in industrialized nations, with an annual incidence of 1 in 1000 persons. The lifetime risk for stone formation is higher in men, with a 13% risk, as compared to women, with a 5% risk. Factors that determine renal stone prevalence include age, sex, race, obesity, insulin resistance, diabetes mellitus type 2, and geographical distribution. Specific types of stones include calcium, uric acid, struvite, and cystine stones. Struvite stones are also known as *infection stones* or *triple phosphate stones*. It can grow rapidly to a large size, reduce renal function in the affected kidney, and is difficult to eradicate [1]. Struvite stones account for 30% of urinary tract stones worldwide. Approximately 75% of staghorn calculi are composed of a struvite-carbonate-apatite matrix [2]. According to Gettman, M. and Segura, J., in their article “Struvite Stones: Diagnosis and Current Treatment Concepts” published in 1999, struvite stones occur more frequently in women, infants, and the elderly as they are at greater risk of harboring urinary tract infections. They stated that patients with diabetes mellitus, or laxative or analgesic abuse are also at increased risk of acquiring struvite stones [3].

In the “Report on the Management of Staghorn Calculi” made by the American Urologic Association in 2005, they stated that staghorn calculi are branched stones that occupy a large portion of the collecting system. They fill the renal pelvis and branch into several or all the calyces. It represents 10% - 20% of all nephrolithiasis cases. They can be either partial or complete. “Partial staghorn” is defined as a branched stone that occupies part but not all of the collecting system while “Complete staghorn” occupies the entire collecting system. Unfortunately, there is no consensus regarding the precise definition of staghorn calculi such as the number of involved calices required to qualify for a staghorn designation. So, the term “staghorn” is often used to refer to any branched stone that occupies more than

one portion of the collecting system [4]. According to Diri, A. and Diri, B., their review, entitled “Management of Staghorn Renal Stones”, stated that although kidney stones occur more commonly in men, staghorn calculi is more often reported in women and is usually unilateral. The occurrence of staghorn calculi carries high morbidity and mortality rates especially when left untreated. Conservative management of staghorn calculi has shown a mortality rate of 28% in a 10-year period and 36% risk of developing significant renal impairment [5].

In the article by Kennedy, K. *et al.* posted on the Urology Group Virginia website, entitled “Staghorn Kidney Stones”, they stated that untreated staghorn calculi can lead to renal deterioration in at least 1 out of 4 patients. Over time, it is likely to destroy the kidney and/or cause life threatening sepsis [6]. The management of staghorn calculi remains a challenge because of its risks and complexity. There is still controversy regarding its management on whether it is safe to do conservative therapy instead of surgery.

In a landmark trial done by Singh and Blandy in 1973, entitled “The Fate of Unoperated Staghorn Calculus”, they noted that leaving the stone *in situ* poses a constant threat to the other kidney and a risk of developing pyonephrosis. Expectant treatment of these cases led to subsequent nephrectomy in half of them and the majority of the rest have died of progressive renal failure. The patients with staghorn calculi are rarely symptom free unless they are operated on. In their study, none of the patients were symptomless on admission and most of their patients presented with pain, hematuria, and infection. They found that those who had a nephrectomy fared better than those in whom the stone was left *in situ*. Thus, they established that the mainstay of treatment was surgical intervention [7].

In an invited review done by Subramonian, K., Barba, H, and Darrad, M., entitled “Role of Conservative Management of Stones” in 2020, they noted there were 8 papers made about the conservative management of staghorn calculi after the landmark study was published. All of them have documented 1 or more combinations of the following parameters: renal deterioration, dialysis requirement, urinary tract infection, and mortality [8]. The largest of these studies was by Koga *et al.* [9].

According to Koga, S. *et al.*, their study in 1991, entitled “Staghorn Calculi—Long-term Results of Management”, they confirmed that asymptomatic patients were few in number (7.8%) and they often have positive urine cultures and may give rise to symptoms sooner or later. The most common symptom presented was flank or abdominal pain. They noted that the mortality rate was higher following conservative therapy as compared to surgery. The deterioration of the kidneys with staghorn calculi was caused by infection and obstruction. Infection was associated in every case and obstruction exacerbated the infection and deterioration. These suggest that both infection and obstruction can become life-threatening and that the morbidity and mortality rates are much higher with conservative treatment. They concluded that surgical management is preferable. Complete removal of staghorn calculi should be performed if the patient’s general condition and age allow [9].

Despite robust literature supporting surgical management on this condition, there are a few studies, though small and limited, that concluded that conservative therapy can be safe in select patients with appropriate monitoring.

In a study done by Deutsch and Subramonian entitled “Conservative Management of Staghorn Calculi: a single-center experience”, they described that the presentations were incidental, hematuria, abdominal discomfort, and recurrent urinary tract infections. They noted that the reasons for choosing conservative therapy were patient’s choice (36%), comorbidities (59%), or poor access/anatomy (5%). They found that the recurrent urinary tract infection rate was 50%, and the progressive renal failure rate was 14%. The disease-specific mortality rate and dialysis dependence rate were both 9%. The rate of hospital attendances attributable to stone-related morbidity was 27%. They concluded that conservative management, especially for those patients who are unfit for surgery or decline intervention, is not as unsafe [10].

According to Morgan *et al.*, they documented that the estimated glomerular filtration rate stayed the same or improved in 66% of the patients in their study following conservative therapy. Patients were asymptomatic and had minor complaints such as bladder infection, gross hematuria, and flank pain. The patients that had an Age-adjusted Charlson Comorbidity Index Scores of < 3 had a 2-year overall survival rate of 95%. During their study period, no patients underwent hemodialysis. They documented 2 deaths wherein one was unrelated and the other was due to urosepsis in a non-compliant patient. They concluded that the outcome of patients conservatively treated was reasonable in this select group [11].

In a study done by Chakraborty, A., Alshamsi, H., Sadri, I., *et al.*, they documented zero stone-related mortality and the lowest documented incidence of progressive renal deterioration at 13% and only 4% required dialysis in patients with staghorn calculi who were managed conservatively. Their survival rate was 87% which is comparable to their expected survival rate of 77% [12]. More studies in the future are needed to provide more information on whether conservative treatment of patients is safe.

3. Significance of the Study

Staghorn calculi can carry significant morbidity and mortality if left untreated. Surgical management has always been the preferred treatment option for staghorn calculi; however, there are some data that suggest that conservative management can be possible. The results of this study will be beneficial to patients afflicted with staghorn calculi as well as the medical community because this will give additional data on the outcomes of conservative management, assess factors that can possibly affect the outcomes such as the co-morbidities, and provide aid in the decision-making for patients who have a poor reserve or high surgical risk. This study will shed additional light on the idea that conservative therapy is potentially safe especially on select patients with appropriate moni-

toring.

4. Research Question

What are the clinical outcomes of conservative management of patients with staghorn calculi admitted in Perpetual Succour Hospital, Cebu from January 1, 2011 to December 31, 2020?

5. Objectives

5.1. General Objective

This study aims to determine the clinical outcomes of conservative management of patients with staghorn calculi admitted in Perpetual Succour Hospital, Cebu from January 1, 2011 to December 31, 2020.

5.2. Specific Objectives

Specifically, this would accomplish the following:

1. Describe the clinicodemographic profile of the patients in terms of
 - 1.1. Age
 - 1.2. Sex
 - 1.3. Ethnicity
 - 1.4. Co-morbidities
 - 1.5. Family history
 - 1.6. Occupation
 - 1.7. Drug history
 - 1.8. Body mass index
 - 1.9. eGFR level
 - 1.10. Signs and symptoms presented
2. Determine the types and size of staghorn calculi present in the patients
 - 2.1. Unilateral
 - 2.2. Bilateral
 - 2.3. Size
 - 2.3a < 2 cm
 - 2.3b 2 to < 5 cm
 - 2.3c 5 to < 7 cm
 - 2.3d ≥ 7cm
3. Determine whether patient was a deemed a poor or unsuitable surgical candidate or declined surgical treatment
4. Assess the reason for poor surgical candidacy
5. Identify the interventions performed on the patients
6. Evaluate the clinical outcomes of the patients

6. Methodology

6.1. Study Design

This is a single center, retrospective study of patients with staghorn calculi, who

had conservative management, admitted in Perpetual Succour Hospital from January 1, 2011 to December 31, 2020.

6.2. Study Setting

This study is conducted in Perpetual Succour Hospital, Gorordo Avenue, Cebu City, Cebu, Philippines

6.3. Population and Sampling Frame

The patients enrolled in this study are chosen through the following criteria:

6.3.1. Inclusion Criteria

1. The patient should be 18 years old and above.
2. The patient is diagnosed with staghorn calculi via computed tomography scan, ultrasound, or intravenous pyelography.
3. The patient received conservative treatment for their staghorn calculi.

6.3.2. Exclusion Criteria

1. The patient is below 18 years old.
2. The patient received surgical treatment for their staghorn calculi.
3. The patient has end-stage renal disease at baseline.
4. The patient is terminally ill at baseline.

6.4. Sample Size Determination

Using Cochran's formula for finite and small population of a known size with a population correction factor, a 10% margin of error, 90% confidence level, and estimated population prevalence of 27%, a minimum of 36 patients out of the total 111 was needed. In this current analysis, 40 patients were included. The study excluded 71 patients as they could not be contacted and follow-up could not be done.

6.5. Data Collection Procedure

Research protocol was submitted and approved by the Institutional Ethics and Review Board (IERB) and hospital administrator. After which, medical charts from January 1, 2011 to December 31, 2020 were retrieved from the medical records section. Selection of patients to be enrolled in the study were chosen through the inclusion and exclusion criteria. The charts of the patients that were included in the study were reviewed, and data was collected to answer the general and specific objectives. The patients enrolled were followed-up once (range of 5-14 years and a median of 8 years since their discharge) through call to evaluate the clinical outcomes and their charts were reviewed. Out of the 111 patients, only 40 were successfully contacted through call. The deaths were then verified through patients' charts. The data of the 71 patients who cannot be reached or contacted thru call were excluded from the study. The data was collated, compared, and analyzed.

Figure 1 shows the flow or algorithm of procedure.

6.6. Statistical Analysis

The clinicodemographic profile of the patients will be described as frequencies and percentages. A simple statistical analysis will be undertaken for the data collated. A chi-square test will be utilized to determine the association of the categorical factors and the clinical outcomes of patients with staghorn calculi managed conservatively.

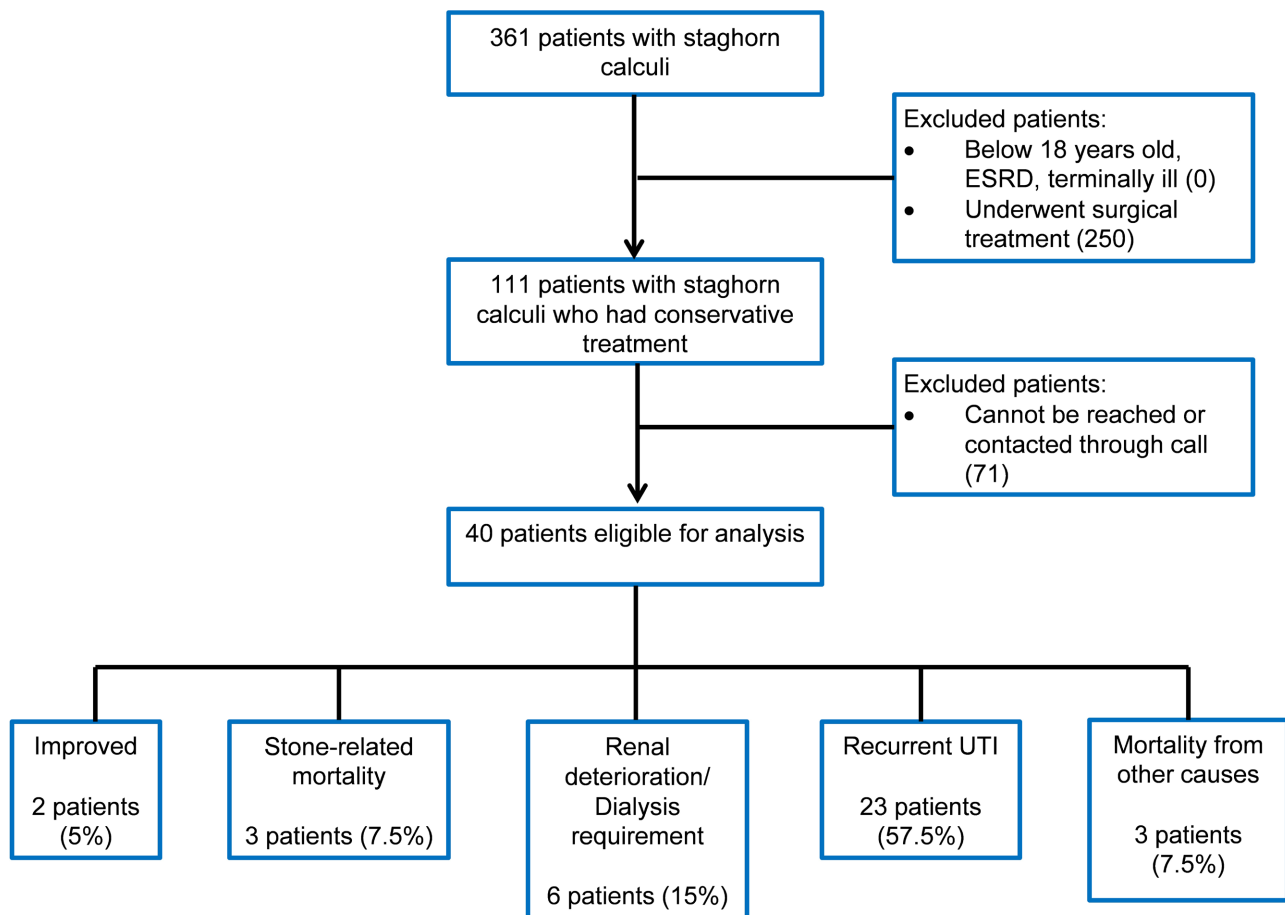


Figure 1. Flowchart or algorithm of the procedure.

7. Definition of Terms

The following terms are operationally defined as used in this study:

1. **Co-morbidities:** the pre-existing medical conditions such as hypertension, diabetes mellitus, cardiovascular disease, pulmonary disease, cerebrovascular disease, liver disease, gastrointestinal disease, stone formers, and malignancy.
2. **Estimated glomerular filtration rate:** a test that measures the level of kidney function utilizing the creatinine, age, gender, and weight of the patient. It determines the stage of kidney disease.
3. **Staghorn calculus:** a large stone that occupies a more than one branch of the collecting system. They fill the renal pelvis and branch into several or all the calyces. It can be diagnosed thru computed tomography scan, ultrasound, or intravenous pyelography.

4. **Conservative management:** interventions that are non-surgical removal, such as medical management with antibiotics, pain relievers, α -adrenergic blockers, urine alkalinizers (potassium citrate, sodium bicarbonate), anti-spasmodics (rowatinex, HNBB), anti-urolithiasis (sambong), hydration, DJ stenting, or nephrostomy tube insertion. While, in technical terms, DJ stenting and nephrostomy tube insertion is a temporizing procedure, it can be considered part of a broader “conservative” strategy when it is used to avoid more aggressive or permanent open surgeries or organ removal.
5. **Surgical intervention:** removal of the stone via surgery, either open or closed, such as percutaneous nephrolithotomy, pyelolithotomy, shock-wave lithotripsy, a combination, or nephrectomy.
6. **Clinical outcomes:** consequences that resulted from the intervention of the study with only one final outcome category for each patient; either recurrent episodes of urinary tract infection, renal deterioration leading to dialysis requirement, or stone-related mortality.
 - a. **Improved:** a decrease in creatinine or a rise in eGFR, no urinary tract infection, no progression of the stone causing obstruction.
 - b. **Renal deterioration:** decline in kidney function as measured by a progressive drop in eGFR, rise in creatinine, or decreasing urine output, and can sometimes lead to hemodialysis.
 - c. **Stone-related mortality:** in this study, it is defined as death caused by complications from lithiasis such as urosepsis or septic shock secondary to complicated urinary tract infection.
 - d. **Recurrent urinary tract infections:** repeated occurrence of urinary tract infections (infection that affects any part of the urinary tract), either having 2 or more episodes within 6 months or at least 3 within a year, or hospital re-admissions due to urinary tract infection.

8. Results

After subjecting to both inclusion and exclusion criteria, out of 111 medical charts from 2011 - 2020, only 40 records were included in the analysis. Data were then tabulated, analyzed and interpreted in this section. Results are shown as follows:

Table 1. Clinico-demographic profile of the patients with staghorn calculi from 2011 - 2020 (n = 40).

Profile	Category	f	%
Age (years)	31 to 40	3	7.50
	41 to 50	7	17.50
	51 to 60	14	35.00
	More than 60	16	40.00
Sex	Female	24	60.00
	Male	16	40.00
Ethnicity	Filipino	40	100.00

Continued

Body mass index (kg/m ²)	Underweight < 18.5	1	2.50
	Healthy Weight 18.5 to < 25	15	37.50
	Overweight	10	25.00
	Obesity Class 1	5	12.50
	Obesity Class 2	1	2.50
	No Data	8	20.00
Co-morbidities	Hypertension	23	57.50
	Diabetes Mellitus	12	30.00
	Bronchial Asthma	0	0.00
	Stone-former	10	25.00
	Thyroid disease	2	5.00
	Post-CVD infarct	1	2.50
	Hypokalemic periodic paralysis	1	2.50
	Gouty Arthritis	1	2.50
	Alzheimer's Disease	1	2.50
	None	9	22.50
Family history	Hypertension	19	47.50
	Diabetes Mellitus	15	37.50
	Bronchial Asthma	3	7.50
	Stone formers	2	5.00
	Cardiovascular disease	3	7.50
	Thyroid disease	2	5.00
	Malignancy	4	10.00
	None	14	35.00
Occupation	With	18	45.00
	Without	22	55.00
History of illicit drug use	Yes	0	0.00
	No	40	100.00
Smoker	Yes	8	20.00
	No	32	80.00
Alcoholic beverage drinker	Yes	11	27.50
	No	29	72.50
eGFR level	>90	1	2.50
	60 - 89	9	22.50
	45 - 59	5	12.50
	30 - 44	10	25.00
	15 - 29	7	17.50
	<15	8	20.00

Continued

Signs and symptoms presented	Flank pain	14	35.00
	Abdominal pain	3	7.50
	Hematuria	4	10.00
	Dysuria	4	10.00
	Fever	12	30.00
	Chills	2	5.00
	Urinary Frequency	2	5.00
	Body malaise	1	2.50
	Presence of urine sediments	2	5.00
	Dizziness	2	5.00
	Incidental findings	4	10.00
	Asymptomatic	0	0.00

Table 1 shows the different basic demographic and clinical profiles of patients with staghorn calculi from 2011 - 2020 who underwent conservative management. It can be shown that all these patients were Filipinos, mostly senior citizens (40%) followed by the elderlies who aged 51 - 60 years old (35%) and who were mostly dependents (55%). Also, female patients were more common (60%) than their male counterparts (40%). Though a large proportion of patients registered to be in healthy weight (37.50%), most of them had common comorbidities such as hypertension (57.50%), diabetes (30.00%) and stone-formers (25.00%) which were also traced to their family histories.

None of these patients had history of illicit use of drugs, 20% were smokers and 27.50% were alcoholic beverage drinkers. In terms of eGFR level, a large fraction of these patients recorded 30 - 44 (25%) followed by those who had 60 - 89 (22.5%) and < 15 (20%). Flank plain (35%), fever (30%), hematuria, dysuria and incidental findings (10%) apiece presented as the most common signs and symptoms.

Table 2. The types and size of staghorn calculi present in the patients (n = 40).

Characteristics	Category	f	%
Type of staghorn calculi	Unilateral (Left)	16	40.00
	Unilateral (Right)	19	47.50
	Bilateral	5	12.50
Size of staghorn calculi	<2 cm	3	7.50
	2 to < 5 cm	17	42.50
	5 to < 7 cm	5	12.50
	≥7 cm	7	17.50
	No Data	8	20.00

Table 2 depicts that a more common type of staghorn calculi was unilateral

(right) with 47.50% while unilateral (left) comprised 40.00% of the total sampled patients. There were 12.50% of them who had bilateral cases of staghorn calculi.

Table 3. Patient Status in terms of poor surgical candidate or declined surgical treatment (n = 40).

Characteristics	Category	f	%
Patient status	Unfit for Surgical Intervention	33	82.50
	Refused Intervention/Home Against Medical Advise	7	17.50

Table 3 shows that in terms of patient status, a huge majority of the patients were deemed unfit for surgical intervention (82.50%) while 17.50% refused intervention or went home against medical advice.

Table 4. Reasons for poor surgical candidacy (n = 40).

Reasons why Unfit for Surgery	f	%
Ongoing UTI	14	35.00
Sepsis/Septic shock	13	32.50
CVD infarct	1	2.50
Disorientation	1	2.50
Fracture	1	2.50
No indication	3	7.50

Table 4 indicates that some known reasons for poor surgical candidacy of patients were most commonly due to ongoing infection (35.00%) and Sepsis/Septic Shock (32.50%). Some patients (7.50%) also presented with no indication while others had CVD infarct, disorientation or fracture.

Table 5. Interventions performed on the patients (n = 40).

Characteristics	Category	f	%
Management and intervention done for the patients	Hydration	30	75.00
	Antibiotics	36	90.00
	Urine Alkalinizers	25	62.50
	Pain reliever	15	37.50
	Anti-urolithiasis	2	5.00
	Anti-spasmodics	4	10.00
	Alpha-blockers	2	5.00
	DJ stenting	11	27.50
	Nephrostomy tube insertion	3	7.50

Table 5 shows the several management and interventions performed on the patients showing that antibiotics and hydration were the most common at a rate of 90% and 75% respectively. This was then followed by treatment with the use of Urine Alkalinizers at 62.50%, pain reliever at 37.50 and DJ stenting and 27.50%.

Table 6. Clinical outcomes of the patients (n = 40).

	f	%
Improved	2	5.00
Stone-related Mortality	3	7.50
Renal deterioration/Dialysis Requirement	6	15.00
UTI/Recurrent UTI	23	57.50
Mortality from other causes	3	7.50
Morbidity from other causes	3	7.50

Table 6 shows that in terms of clinical outcomes, only 3 out of the 40 patients had a stone-related mortality. This was followed by 2 out of the 40 patients (5%) had improved conditions. Meanwhile, 57.50% had UTI/Recurrent UTI and 15% succumb to Renal deterioration/Dialysis Requirement.

Association between Clinical and Demographic Profiles and the Clinical Patient Outcomes

Table 7. The Association of Clinicodemographic profile and the Clinical Outcomes of patients (n = 40).

Predictors	Chi-square value	p-value	Decision	Interpretation	Remarks on Outcomes
Age	18.34	0.22	Do not Reject Null	No Significant Association	
Sex	1.87	0.88	Do not Reject Null	No Significant Association	
Body mass index	38.54	0.04	Reject Null	Significant Association	13% of healthy patients improved while 70% and 80% of overweight and obese class 1 respectively had UTI/Recurrent UTI
eGFR level	41.43	0.02	Reject Null	Significant Association	50% of patients with < 15 had Renal deterioration/Dialysis Reqt while 90% of patients 30 - 44 had UTI/Recurrent UTI. Of the 2 who Improved, they all had eGFR level of 45 - 59
Smoker	2.69	0.75	Do not Reject Null	No Significant Association	
Alcoholic beverage drinker	6.3	0.28	Do not Reject Null	No Significant Association	
Type of staghorn calculi					
Unilateral (Left)	2.56	0.77	Do not Reject Null	No Significant Association	
Unilateral (Right)	1.29	0.94	Do not Reject Null	No Significant Association	
Bilateral	3.96	0.56	Do not Reject Null	No Significant Association	
Size of staghorn calculi	16.88	0.66	Do not Reject Null	No Significant Association	

*Association is Significant at X^2 p-value < 0.05.

Table 7 shows that both BMI and eGFR levels were significantly associated with the likelihood of outcomes of patients with Staghorn Calculi who were managed conservatively. It can be averred from the results that 13% of healthy patients improved while 70% and 80% of overweight and obese class 1 respectively had UTI/Recurrent UTI while 50% of patients with < 15 had Renal deterioration/Dialysis Requirement while 90% of patients 30 - 44 had UTI/Recurrent UTI. Of the two patients who Improved, they all had eGFR level of 45 - 59.

Table 8. The Association of Comorbidities and the Clinical Outcomes of patients (n = 40).

Predictors	Chi-square value	p-value	Decision	Interpretation	Remarks on Outcomes
Co-morbidities					
Hypertension	2.88	0.72	Do not Reject Null	No Significant Association	
Diabetes mellitus	14.08	0.02	Reject Null	Significant Association	25% of patients with Diabetes had Renal deterioration/Dialysis Reqt, Stone-related Mortality or UTI/Recurrent UTI
Post-CVD infarct	12.65	0.325	Do not Reject Null	No Significant Association	A patient with this comorbidity has Mortality from other causes
Gouty Arthritis	12.66	0.325	Do not Reject Null	No Significant Association	The patient who had gouty Arthritis had Stone-related Mortality

*Association is Significant at X^2 p-value < 0.05.

Table 8 shows data from additional probing or exploration on the association of comorbidities with the clinical outcomes. It showed that diabetic patients had a significant association with the clinical outcomes and there was no significant association with hypertension, post-CVD infarct, and gouty arthritis. 25% of patients with Diabetes had Renal deterioration/Dialysis Requirement, Stone-related Mortality or UTI/Recurrent UTI. It was also noted that post-CVD infarct comorbidity has Mortality from other causes and a patient who had gouty arthritis had stone-related mortality.

9. Discussion

In the study, we noted that most of the patients were senior citizens or aged 60 years old and above and were dependents. They were predominantly female and all were Filipinos. Most of these patients were in the healthy weight class with a body mass index between 18 to less than 25 kg/m². However, most of them also had hypertension followed by diabetes mellitus. Also, most of them had a family history of hypertension followed by diabetes mellitus. A large portion of these patients had no vices such as smoking, alcohol beverage drinking, nor illicit drug use. And at the time of diagnosis, most of them had an eGFR level of 30 - 44. This was consistent with what was stated in the literature that struvite stones more frequently occurs in females and elderly, or staghorn calculi was frequently reported in females, and that patients with diabetes mellitus are also at increased risk for acquiring them. Also, in this study, not only patients with diabetes mellitus had

the staghorn calculi but also hypertensive patients as well.

In the study, majority of the patients presented with flank pain then followed by fever. This is congruent with the study done by Koga, *et al* in 1991 wherein they established that the most common symptom presented was flank pain. This was also consistent with the landmark trial done by Singh and Blandy which stated that the symptoms presented were pain, infection, and hematuria. Also, as compared to the study done by Morgan, *et al.* wherein they had patients who did not present with any symptom and the study by Singh and Blandy wherein they did not have any patients who were asymptomatic; none of the patients in this study were asymptomatic. This further clinches what was stated in literature that patients with staghorn calculi are rarely symptom-free.

The patients in the study most commonly presented with a unilateral staghorn calculi, more on the right. And most of them had a staghorn calculi as big as 2 to < 5 cm. This finding is compatible with the literature indicating that patients usually had unilateral staghorn calculi.

In the study, a large fraction of the patients were deemed unfit for surgical intervention and only a few declined intervention. As compared to the study done by Deutsch and Subramonian wherein they established that the reasons for choosing conservative therapy were mostly comorbidities, followed by patient's choice, or poor access/anatomy, this study showed the reason for poor surgical candidacy was most commonly due to ongoing urinary tract infection, followed by sepsis or septic shock and none were because of poor access/anatomy. This signifies that having an ongoing infection especially if severe might subject the patient to an increased risk of significant morbidity or mortality if subjected to surgery at that moment. A greater portion of these patients were given antibiotics, followed by hydration, then urine alkalinizers as conservative treatment for their staghorn calculi.

In terms of clinical outcomes, the study determined that most of the patients had an episode of urinary tract infection or recurrent urinary tract infection and only a few patients, around 15%, had renal deterioration leading to dialysis. Only 7.5% of the patients had a stone-related mortality. As opposed to the study done by Koga *et al.* in 1991 entitled "Staghorn Calculi—Long-term Results of Management" wherein they noted that mortality rate was higher following conservative therapy, and the review done by Diri, A. and Diri B. in 2018 wherein they stated that conservative management of staghorn calculi has shown a mortality rate of 28% in a 10-year period and 36% risk of developing significant renal impairment, this study noted a lower mortality rate which was only 7.5% among the patients who had conservative management and only 15% had dialysis requirement. Also, in comparison with the study done by Deutsch and Subramonian in 2016 wherein they stated they had a low disease-specific mortality and dialysis dependence rate of 9%, this study also matches with a lower mortality rate of 7.5% but the dialysis requirement is slightly higher. Though in contrast to the study done by Chakraborty, A., Alshamsi, H., Sadri, I. *et al.* wherein they documented a zero stone-related mortality and the lowest incidence of progressive renal deterioration

requiring dialysis, this study had 3 stone-related mortality and a slightly higher incidence of dialysis requirement. With these data presented, the study established that it is congruent with what was stated in the literature that conservative management of staghorn calculi can be done instead of surgical intervention especially in select patients with comorbidities.

Interestingly, the study additionally explored the association of the clinicodemographic profiles and comorbidities with the clinical outcomes. We noted that among the clinicodemographic profiles presented, most of those who were overweight, obese class 1, and had an eGFR of 30 - 44 had urinary tract infection or recurrent urinary tract infection. Only half of the patients who had an eGFR of < 15 went into further renal failure requiring dialysis. Also, those 2 patients who had completely improved outcomes had an eGFR of 45 - 59. Among the comorbidities presented, those who had diabetes mellitus showed renal deterioration requiring dialysis, urinary tract infection, and stone-related mortality and it was a significant association. The patient who previously had a CVD infarct showed mortality from another cause. Lastly, the patient who had gouty arthritis experienced a stone-related mortality. However, there was no significant association with CVD infarct and gouty arthritis with the clinical outcomes.

10. Limitation of the Study

The study did not tackle on other patient factors such as previous history of surgical interventions for nephrolithiasis, having a positive culture or looking into urine culture growth for patients who had sepsis, measurement of kidney function through a glomerular filtration rate scan or GFR scan, and stone analysis. Other factors that could affect the outcome such as the length of hospital stay, were also not included in the study. The patients were followed-up once since their admission via phone call. The study was conducted in only one tertiary hospital or institution.

11. Conclusion

Based on the analysis of the data gathered, the clinicodemographic profiles of the 40 patients diagnosed with staghorn calculi were mostly female, Filipino, aged 60 years old and above, and were in the healthy weight class with a BMI of 18 to less than 25 kg/m². They were mostly hypertensive and diabetic with a family history of hypertension and diabetes mellitus. Most of the patients were non-smokers, non-alcoholic beverage drinkers, with no history of illicit drug use, and had an eGFR of 30 - 44 at the time of diagnosis. They most commonly presented with flank pain followed by fever and had a unilateral staghorn calculi with a size between 2 to < 5 cm. Most of them were poor candidates for surgical intervention with the reason being most commonly due to urinary tract infection, followed by sepsis or septic shock. Instead of surgical treatment, these patients most commonly received antibiotics, followed by hydration, then urine alkalinizers. We found that, among the patients with staghorn calculi who received conservative

management, most of them (15%) had urinary tract infection or recurrent urinary tract infection, and only 3 (7.5%) patients were noted to have a stone-related mortality and only 6 (15%) patients required dialysis.

Recommendations

The researcher would like to recommend the following for future studies:

1. To conduct a prospective study on the conservative management of staghorn calculi
2. To conduct the study on other tertiary hospitals/institutions in Cebu City
3. To enroll more patients in the study
4. To compare the outcomes of surgical versus conservative management of staghorn calculi
5. To further look into association of clinico-demographic profiles or risk factors that can affect the outcome

To investigate additional factors that might affect the outcomes such as urine culture results or GFR scan.

Conflicts of Interest

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

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