ORIGINAL RESEARCH

Determination of Factors Affecting Stone Free Rates of Primary Percutaneous Nephrolithotripsy (PCNL) in a Tertiary Government Hospital

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Introduction and Objectives: Percutaneous nephrolithotripsy (PCNL) is the first-line treatment for stone burden >2 cm. The aim of this study was to determine factors that would affect stone free rates after PCNL. Preoperative and intra-operative variables were correlated to the patient's post-operative outcomes to find a link, or lack thereof, to stone-free outcomes.

Methods: A retrospective study of patients who underwent primary PCNL was done over a 1-year period. The association of the stone characteristics (based on Guy stone score), stone burden, operative time, lithotripsy time, number of access tracts, and location of access tracts to the stone-free status were analyzed.

Results: One hundred thirty patients who underwent PCNL were included in this study. Stone free rate was 77.69% (101/130) while 23 of the 29 patients with residual stones (22%) (29/130) required further treatment. The 30-day overall morbidity rate was 8.46% (11/130). Guy stone score (GSS) and stone burden were found to be significantly associated with stone-free status. Patients with GSS grade I had the highest stone-free rate of 95.45% while patients with GSS Grade IV had the lowest stone-free rate at 30.00%. After multivariate analysis, stone burden (OR 1.176; 95% CI 1.084- 1.275; p 0.00) and GSS 4 (OR 15.374; 95% CI 1.164- 202.980; p 0.04) were significant independent risk factors for stone-free status.

Conclusion: Stone clearance and complication rate after PCNL of the present study were 78% and 8.5%, respectively, comparable with published data. A higher Guy's stone score and a higher stone burden were significantly associated with retained stones post-PCNL.

Key words: percutaneous nephrolithotripsy, stone-free rate, stone characteristics, stone burden

Introduction

Urinary stone incidence depends on geographical, climatic, ethnic, dietary and genetic factors.[1] The prevalence rates of urolithiasis range from 5% -19.1% in most of the Asian region, although, relatively low prevalence rates of 1%-8% were noted in East Asia and North Asia.[2] Treatment largely depends on the stone size, renal anatomy, location, stone composition (hardness), and symptoms of the patient.

Advances in extracorporeal shock wave lithotripsy (ESWL) and endourological surgery have significantly decreased the indications for open or laparoscopic stone surgery.[1] Renal stone sizes greater than 2cm or stones that are too hard for ESWL are treated primarily by percutaneous nephrolithotripsy. Percutaneous nephrolithotripsy (PCNL) has become the first-line treatment for large burden of stones (>2 cm), stones resistant to extracorporeal shock wave lithotripsy (ESWL) and multiple and inferior calyx renal stones .[1] PCNL has stone-free rate three times higher than ESWL and has lower morbidity, shorter length of hospital stay, shorter operating time, and time to return to work faster than open surgery.[3]

The main goal for urolithiasis intervention is to achieve a stone free status.[4] It is crucial to completely remove all stones because residual stones can form nuclei for stone recurrence that may lead to infection.[3] Residual stones after PCNL require further management with medical expulsion therapy (MET), Extracorporeal shock wave lithotripsy (ESWL), re-PCNL, laser intracorporeal lithotripsy, retrograde intrarenal surgery (RIRS), or open surgery. Treatment of residual stones equates to added hospital costs, out-of-pocket expenditure, and prolonged hospital stay. In a developing country, it is essential to have an efficient allocation of hospital resources in terms of overall treatment.

The aim of this study was to determine factors that would affect stone free rates after PCNL. Preoperative and intra-operative variables will be correlated to the patient's post-operative outcomes to find a link, or a lack thereof, to stone-free outcomes. Applications of this study can improve patient selection, individualize treatment modality, and improve management efficiency for patients in a tertiary government hospital.

Methods

This study was conducted among patients who were above 18 years of age and admitted for primary percutaneous nephrolithotripsy for urinary stone disease in a tertiary government hospital from January 2019 to December 2019. Patients admitted for secondary PCNL and those who had incomplete data (>50% of required information missing) were excluded.

Preoperative clinical data included age, gender, comorbidities, stone burden (0.785 x Maximum Length X Maximum Width), stone characteristic (Guy's stone score), presence of bilateral stones, serum creatinine, and presence of a double J stent or a nephrostomy tube prior to PCNL. Intraoperative clinical data and postoperative outcomes were also reviewed and recorded. Where patients had undergone bilateral PCNL within a single admission, both procedures were included in the study.

Sterile urine was required prior to surgery. Urine cultures were taken preoperatively and culture guided antibiotics are given to patients with bacterial growth. The standard operative technique began with the patient put on lithotomy position under general anesthesia. Recommended prophylactic antibiotics were given on anesthesia induction. A six-Fr open-ended ureteral stent was inserted up to the desired calyx of access under fluoroscopic guidance. An indwelling catheter was then inserted and the open ended stent was secured in place. The patient was then put on prone position and access to the target pelvocalyx was done percutaneously using the Bull's eye technique or triangulation technique with an 18-guage puncture needle. A guide wire was then inserted to the collecting system down to the ureter. Consecutive renal dilators were passed over the guidewire up to a French 30 Amplatz working channel thru which the nephroscope was inserted to gain direct visualization of the stone. Isotonic saline was used as the irrigating fluid throughout the procedure. Stone disintegration was achieved using the ultrasonic or pneumatic lithotripter. At the end of the operation, a French 20 nephrostomy tube (NT) was routinely left in place. As division standard of practice, an antegrade pyelogram was done 2 days postoperatively to investigate for any extravasation or retained calculi. The NT was removed after an unremarkable antegrade pyelogram.

Intraoperative clinical data included in the analysis were operative time (mins), fluoroscopy time (mins), access time (mins), lithotripsy time (mins or counts), nephroscopy time (mins), estimated blood loss (ml), blood products transfused (units), amount of irrigation fluid used (liters), number and location of access tracts, and extravasation of fluid. The postoperative clinical data included in the analysis were postoperative blood products transfused (units), residual stones (stones >5mm), management of residual stones, total length of hospital stay (days), postoperative length of stay (days), and other complications.

The course of the patients' hospital stay was reviewed for morbidities and mortality. Perioperative complications were classified according to the Clavien-Dindo system. The out-patient follow-up records were retrieved to determine the same outcomes at 30 days and 6 months after the date of surgery. For patients who were readmitted within 30 days of discharge, or who underwent reoperation/reintervention within 6 months of the initial PCNL, the reason for readmission and reoperation were determined.

The primary outcomes were stone free status, stone-free rate and re-operation or re-intervention rate. Stone free status is defined by the absence of any evidence of residual stones greater than 5mm in size, after the PCNL, as determined by radiography or fluoroscopy at the end of the procedure, without conversion to open surgery. Stone-free rate refers to the percentage of patients who had no residual stones after the first PCNL. Lastly, re-operation or re-intervention rate is the percentage of patients who had to undergo another interventional procedure to achieve stone clearance.

Data Analysis Plan

Continuous variables (e.g. age, length of stay, operative time, stone burden, estimated blood loss, etc.) were expressed as mean ± SD, while categorical variables (e.g. gender, nature of disease, type of surgery, characteristics of stones, presence of complications, etc.) were summarized as counts and percentages. Furthermore, the 95% confidence interval estimates were computed for the following outcomes: 1) stone free rate, 2) complication rate; and 3) reintervention rate.

`Student's T-test (for continuous variables), chi-square test (for categorical variables), and Fisher's exact test (for categorical variables) were performed to determine statistically-significant variables affecting stone-free rates in PCNL, namely: age, sex, diabetes mellitus, immunocompromised state, total stone burden, stone characteristic, bilateral stone disease, anatomic variant or abnormality in KUB imaging, creatinine on admission, presence of a nephrostomy tube or double J stent, total OR time, access time, lithotripsy time, nephroscopy time, fluoroscopy time, number of access tracts, location of access tracts, net water, extravasation of fluid, estimated blood loss, and intraoperative blood product transfusion.

Finally, a multivariate analysis, specifically, binary logistic regression analysis was performed to find the best predictor/s affecting stone free rates.

The study protocol was reviewed and approved by the University of the Philippines-Manila Research Ethics Board and the study was conducted accordance with ICH-GCP principles, the provisions of the National Ethical Guidelines for Health and Health-related Research of 2017, and the Data Privacy Act of 2012 (RA 10173).

Results

Population Characteristics

From January to December 2019, one hundred thirty-three patients underwent percutaneous nephrolithotripsy at a tertiary government hospital. The mean patient age was 48.98 years (SD= 11.54, Range 25-76). Sixty-nine (53%) were males and sixty-one (47%) were females. Fifteen (11.5%) patients were diagnosed with diabetes. Eighty six (66%) patients had unilateral stones while 44 (34%) patients had bilateral stone disease. Twelve (9%) patients had a double J stent or a nephrostomy tube prior to PCNL while 118 (91%) patients had no stents or tubes preoperatively. The study population was categorized into 2 groups: Stone-free group (101 patients) and Residual stone group (29 patients).

Table 1 shows the preoperative factors with their statistical significance in the stone-free group and residual stone group. Statistically significant preoperative factors identified were stone characteristics and stone burden. From stone characteristic, patients with Guy's Stone Score (GSS) grade I had the highest stone-free rate of 95.45% while patients with (GSS) Grade IV had the lowest stone-free rate at 30.00%. (GSS) Grade II was noted to have a stone-free rate of 86.84% while (GSS) Grade III had a stone-free rate of 78.05%. The mean stone burden of the stone-free group was noted at 5.35 ± 3.91cm while mean stone burden of the residual stone group was at 12.08 ± 9.71cm.

The rest of the preoperative factors were noted to be statistically insignificant, namely: age, gender

Table 1. Preoperative factors in stone-free and residual stone group.

Variable, Total (%)		Stone Free Group	Residual Stone Group	p value
Age		49.67 ± 11.94 95% CI: (47.28,52.05)	46.07 95% CI: (42.46,49.68)	0.139**
Gender Distribution				
	Male	55 (42.31%)	14 (10.77%)	0.489*
	Female	46 (35.38%)	15 (11.54%)	
Comorbidities				
General (Any comorbidity)	Yes	51 (39.23%)	13 (10.00%)	0.387*
	No	49 (37.69%)	17 (13.08%)	
Diabetes	Yes	11 (8.46%)	4 (3.08%)	0.693*
	No	89 (68.46%)	25 (19.23%)	
Immuno-compromised	Yes	2 (1.54%)	0	0.440*
	No	97 (74.62%)	29 (22.31%)	
Hypertension	Yes	36 (27.69%)	6 (4.61%)	0.114*
	No	63 (48.46%)	23 (17.69%)	
Others	Yes	17 (13.08)	4 (3.08%)	0.666*
	No	82 (63.08%)	25 (19.23%)	
Stone Characteristic (GSS)				
	I	21 (17.36%)	1 (0.83%)	<0.001*
	II	33 (27.27%)	5 (4.13%)	
	III	32 (26.45%)	9 (7.44%)	
	IV	6 (4.96%)	14 (11.57%)	
Stone Laterality				
	Unilateral	67	19	0.989*
	Bilateral	34	10	
Preoperative Serum Creatinine		101.41 ± 47.731 95% CI: (91.17,111.64)	96.67 ± 35.296 95% CI: (82.42,110.93)	0.641**
Stone Burden (cm^2)		5.35 ± 3.91 95% CI: (4.53,6.16)	12.08 ± 9.71 95% CI: (8.16,16.00)	<0.001**
Presence of DJS/NT prior to PCNL				
	Yes	10 (13%)	2 (1.54%)	0.603*
	No	89 (68.46%)	29 (22.31%)	

*Chi-square test
**Independent Samples T-test

distribution, urological anatomic abnormalities, comorbidities, stone laterality, preoperative serum creatinine, and presence of a nephrostomy tube (NT)/ double J stent (DJS) prior to PCNL.

Table 2 shows the characteristics of the two outcome groups according to intraoperative factors. Multiple intraoperative characteristics were noted to be statistically significant, namely: operation time, nephroscopy time, lithotripsy time (pneumatic/ counts), fluoroscopy time, and number of access tracts. A higher operative time, nephroscopy time, lithotripsy time (pneumatic/counts), fluoroscopy time, and number of access tracts were seen in the residual stone group. Statistically insignificant factors noted were access times, lithotripsy time (ultrasonic/min), amount of irrigation fluid used, and location of access tracts.

Table 3 enumerates the postoperative outcomes. Complete stone clearance was achieved in 101 out of 130 cases, hence, the computed stone free rate is at 77.69% . 29 out of 130 cases had residual stones post operatively and 23 out of the 29 had further treatment: 17 required completion PCNL, 4 required medical expulsion therapy, and 2 required extracorporeal shockwave lithotripsy (ESWL) for the residual stones. The average size of residual stones after PCNL was at 1.59 cm ± 1.63 (n=23). Location of residual stones was noted at the pelvis 2 times, superior calyx 8 times, middle calyx 10 times, and inferior calyx 14 times. Note that most cases had multiple locations of residual stones.

The 30-day morbidity rate was at 8.46% (11/130). There were no mortalities. Five (3.84%) patients required blood transfusions while 2 (1.54%) cases developed urosepsis. One (0.77%) case converted to a nephrectomy for an avulsed segmental artery while one (0.77%) developed a perinephric hematoma post op. Another (0.77%) developed pleural effusion which was managed by chest tube thoracostomy and another (0.77%) had endotracheal intubation associated-disseminated TB necessitating admission into an intensive care unit. The modified Clavien Dindo grade distribution of complications are: No complication (91.54%), I (4.61%), II (1.54%), IIIa (0%), IIIb (0.77%), IVa (0.77%), IVb (0%), or V (0%). Extravasation of fluid or inadvertent perforation in the pelvocalyceal system was not classified under

Table 2. Intraoperative characteristics of stone free and residual stone group.

	Stone free	Residual Stone	p value
Operation Time (min)	104.02 ± 39.727 95% CI: (95.34, 111.88)	138.52 ± 37.709 95% CI: (125.70,455.56)	<0.001
Access Time (min)	8.60±6.18 95% CI: (6.85,9.44)	8.79±5.45 95% CI: (6.51,10.82)	0.900
Nephroscopy Time (min)	48.19 ± 31.03 95% CI: (41.90,54.48)	64.61 ± 40.61 95% CI: (48.86,80.35)	0.024
Lithotripsy Time (min) Ultrasonic Lithotripter	11.13 ± 9.40 95% CI: (9.11,13.52)	15.65 ± 14.86 95% CI: (9.52,21.79)	0.093
Lithotripsy Time (counts) Pneumatic Lithotripter	730.45 ± 644.96 95% CI: (444.49,1016.41)	2001.50 ± 2370.93 95% CI: (-19300.45,23303.45) *variation too high*	0.045
Fluoroscopy Time (min)	9.82 ± 6.65 95% CI: (8.49,11.27)	13.52 ± 6.79 95% CI: (10.89,16.16)	0.017
Amount of Irrigation Fluid Used (liters)	1.180 ± 2.89 95% CI: (0.57,1.78)	0.74 ± 0.95 95% CI: (0.39,1.13)	0.200
Location of Access Tracts			
-Superior	84	27	0.083
-Middle	12	4	0.423
-Inferior	15	5	0.567
Number of Access Tracts	Count:	Count:	
1	83	19	0.046*
2	14	10	
3	1	0	

*Chi-square Test

Table 3. Postoperative outcomes of PCNL.

		Number		Percentage
Morbidity/ Complications (Clavien Dindo Classification)				
Any		11		8.46%
Bleeding				
-Bleeding requiring blood Transfusion (I)		5		3.84%
-Perinephric Hematoma (I)		1		0.77%
-Nephrectomy (IIIB)		1		0.77%
Sepsis (II)		2		1.54%
Pleural effusion (IIIA)		1		0.77%
Intubation-disseminated TB (IV)		1		0.77%
Patients discharged with NT		3		2.3%
PCNLs rendered stone- free		101/130		77.69%
Patients with residual stone		29/130		22.3%
Location of residual stone				
Superior calyx		8		27.59
Middle calyx		10		34.48
Inferior calyx		14		48.28
Pelvis		2		6.90
Size of residual stone for those with retained stones post- PCNL		Mean: 1.59 cm ± 1.63 (n=23)		Range- 95% CI: (0.8820,2.2884)
Planned Management of Residual Stone	Any Management	23 / 29		79.3%
	ESWL	2		8.7%
	MET	4		17.4%
	Re-PCNL	17		73.9%
Hospital stay (days)		Stone Free Grp: 8.08 ± 5.74 95% CI : (6.93,9.24)	Residual Grp: 10.79 ± 4.82 95% CI : (8.96,12.63)	p-value = 0.023 *

*T-test

morbidity for no intervention was necessitated and leaving a nephrostomy tube post-operatively is the institution's standard protocol. The average length of hospital stay for the stone free group was at 8.08 days (range: 2.34 - 13.82) and 10.79 days for the residual stone group (range: 5.97 – 15.61); a significantly longer stay for residual stone group.

Table 4 enumerates the percentages of having residual stones post operatively for non-staghorn and staghorn calculi. Ten percent of patients with non-staghorn calculi had residual stones postoperatively with GSS Grade I having the lowest percentage of having residual stones postoperatively at 4.55%. It was noted that 60.53% of staghorn calculi (partial and full) had residual stones postoperatively with GSS Grade IV having the highest percentage of residual stones postoperatively at 70%.

Analyzing the independent T-test samples of the total stone burden of the stone-free group and residual tone group, a significant difference in stone burden between the two groups is noted. Looking further into the data, given a patient with a stone burden of less than 7.44cm, we can be 68% confident that the patient will be stone free. Out of all the tests done in the preoperative factors above, only total stone burden and stone characteristic are noted to be significant. This is further shown when a logistic regression was done to predict stone clearance.

From multivariate analysis (Table 5), it was determined that stone burden (OR 1.176; 95% CI 1.084- 1.275; p 0.00) and Guy's Stone Score (GSS) 4 (OR 15.374; 95% CI 1.164- 202.980; p 0.04) were significant independent risk factors for stone-free status.

Discussion

This one-year review of percutaneous nephrolithotripsies done in a tertiary government hospital is the largest retrospective study in terms of PCNL in the Philippines. This study affirms that this tertiary government hospital is a high-volume medical center for PCNL with more than 130 cases done per year. This study noted similar significant factors as seen in the studies done by Atmoko, et al.,[3] and Poudyal, et al., [10]. Atmoko, et al.,[3] noted that stone burden was a factor that determined stone clearance after PCNL but also noted that ipsilateral renal stone surgery was another prognostic factor for stone clearance. In this study, ipsilateral renal stone surgery was observed as a preoperative patient factor. Similar to this study, Poudyal et al.,[10] also determined that stone burden, stone location, and number of calyces involved by the stone are the principal factors determining stone clearance. From the analysis, a stone burden less than 7.44cm noted a 68% confidence of stone-clearance. This outcome can significantly guide surgical planning and preoperative patient advice and counseling.

In this study, stone burden and stone characteristic based on GSS was noted to be associated with stone free status. Nahas et al.,[11] found an association between stone burden and secondary calyceal stones with stone-free rate. They also noted that secondary stones sometimes require multiple access or use of flexible nephroscopy to achieve stone-free status. Although multiple PCNL access equates to a higher incidence of complications. Nahas, et al.,[11] also noted that independent risk factors for residual stones were complete staghorn stone and presence of calyceal stones. A Guys Stone Score of 4 was also found to be an independent factor for stone free status in this study. Atmoko, et al.,[3] also had similar significance

Table 4. General significant results- Stone characteristics.

	Stone Free Group	Residual Stone Group	% With Residual Stones
Non-staghorn	54	6	10.00%
GSS Grade I	21	1	4.55%
GSS Grade II	33	5	13.16%
All staghorn (either partial or full)	38	23	60.53%
GSS Grade III	32	9	21.95%
GSS Grade IV	6	14	70.00%

Table 5. Multivariate analysis (logistic regression model) of factors independently predictive of stone-free rate.

Step	Preoperative Factor	Coefficient	p-value	OR (CI 95%)
Step 1	Total Stone Burden (in cm)	0.086	0.100	1.090 (0.984-1.207)
	GSS 1 (reference)		0.165	
	GSS 2	1.047	0.356	2.850 (0.309-26.320)
	GSS 3	1.409	0.207	4.090 (0.458-36.532)
	GSS 4	2.733	0.038	15.374 (1.164–202.980)
Step 2	Total Stone Burden (in cm)	0.162	<0.001	1.176 (1.084-1.275)

*Guys Stone Score (GSS)

but they did not perform any nephrolithometry scoring, rather they divided the category into 2 groups based on stone burden namely, <52mm group and >52mm group. Based on the data, stone clearance is inversely correlated to the patient's Guys Stone Score (GSS). The single pelvocalyceal stones had the highest stone-free rate of 95.45% while full staghorn stones had the lowest stone-free rate at 30.00%. At the current time, the GSS system, the S.T.O.N.E. Nephrolithometry scoring system and the CROES nomogram are used for the prediction of the success rate and possible complications following PCNL in research and clinical practice.[16] They noted that the higher score was inversely related to stone clearance and was associated with post-operative complications.

The results of this study reflect the outcomes of PCNL in a tertiary public hospital in a developing country. The stone free rate of this tertiary government hospital after PCNL was noted to be comparable to the results of developed countries presented in the Clinical Research Office of the Endourological Society (CROES) collected prospective data. The CROES study noted an overall 75.7% stone-free rate achieved by PCNL while this study noted a 77.69% (101/130) stone-free rate. The stone-free rate of this tertiary hospital was also comparable to studies from large, single centers which cite stone clearance rates ranging from 65-94.4%.[3,10,15] A resource-constrained health care system would affect outcomes in terms of available technology for stone disintegration. An important note in this study is that stone-free outcomes were determined by radiography (C-arm machines) and none were confirmed via computerized tomography (CT). It is therefore likely that the true overall stone-free rate is lower than that reported, given the lower sensitivity of radiography compared with CT.[7] It is therefore prudent that surveillance for stone recurrence for this population be augmented. Although, it can be argued that plain radiography and intravenous urography are inexpensive imaging studies and therefore cost-effective especially in developing countries.

Multiple intraoperative characteristics were noted to be statistically significant, namely: operation time, nephroscopy time, lithotripsy time (pneumatic/counts), fluoroscopy time, and number of access tracts. In the correlation of data, it is apparent that there is a significant difference in the said characteristics between the stone free group and the residual group. To determine causation, intuition states that the less stone complexity and burden lead to better intra-operative times and parameters. Although statistically significant, it is not advisable to use these characteristics as predictive factors for stone-free outcomes because they are dependent on the patient's preoperative characteristics, specifically, stone burden and stone characteristics. These parameters merely reflect the complexity of the procedures for the patients with significantly high stone burden or difficult stone configuration.

The average size of residual stones after PCNL was noted at 1.59 cm ± 1.63 (n=23). Size of residual stones post operatively noted in this study was much higher compared to the study by Ganpule, et al.,[5] and Raman et al.,[9] which were 38.6mm ± 52mm (mean) and 2mm (median), respectively. The larger residual stone size could be attributed to the large difference in stone burden for the residual group and stone-free group. In comparison to the CROES Global Study[7], the proportion undergoing further treatment was only 15% of the patients who had residual stones while in the present data, 79.3% of the patients with residual stones had further treatment. This could be correlated to the significantly larger mean residual stone size that would necessitate further intervention to achieve complete stone clearance.

The operation time is also another important factor as intuitively, longer operating times lead to an increased risk for possible complications. The mean operation time of this study was 104.02 ± 39.73 mins for the stone free group and 138.52 ± 37.71 mins for the residual stone group. Both of which were higher in comparison to the studies of Atmoko, et al.,[3] and Huang, et al.,[17]. In Atmoko, et al., they noted the mean length of surgery at 79.55± 34.46 mins and Huang, et al., noted a mean operating time of 63.5± 11.8 mins. Huang, et al.,[17] did not use a ureteral catheter to save on operating time and reduce complications.

This study had a comparable complication rate at 8.6%. The Clinical Research Office of the Endourological Society (CROES) Global study[7] and Armitage and associates[8] noted complications at 15% and 9%, respectively. Armitage, et al.,[8] noted 13 (0.2%) in-hospital deaths within 30 days of surgery and this study did not note any mortality. Although, three complications were categorized as a Clavien Dindo Grade IIIA or higher.

In comparison to international researches, the difference in the operative technique is largely dependent on the available technology of the institution. In the study of Atmoko, et al.,[3], the pelvocalyceal access tract was dilated using metal, fascial, and malleable dilators up to the required size of Amplatz sheath. Poudyal, et al.,[10], used metallic telescopic dilatation or single shot dilatation for their access tract. In this study, dilatation of the access tracts was achieved with the use of re-sterilized plastic renal dilators. In the study by Nahas, et al.[11], flexible nephroscopy was used in some patients to retrieve stones away from the initial puncture while most studies, including this study, used a 24-F rigid nephroscope. Atmoko, et al.[3] used mechanical lithotripsy to clear renal stones while this study used a combination of ultrasonic and pneumatic lithotripsy for stone disintegration. Despite the differences in technique and availability of reliable instruments, this study had comparable stone free rates and complication rates to other larger center studies.

Limitations

A major limitation of this study is the sample size and the encompassed time period. In comparison to other international studies, the time span of their research lasted more than a year or half a decade, and thus would have a larger sample size deriving at more representative outcomes. Like in other retrospective studies, a problem in this study includes selection bias and missed important clinical data. Another limitation that could have affected outcomes is surgeon expertise and experience. As was noted in the methodology, majority of the data provided came from the outcomes of the senior residents doing PCNL. No follow up data collection on outcomes after secondary treatment of residual stones is a shortcoming of this study because analysis of effectiveness of combination therapy could have been done.

Conclusion

This study confirms the findings of previous publications that stone burden and Guys Stone Score are significant preoperative factors that dictate stone free rates and may guide surgical planning and patient counseling. Furthermore, PCNL outcomes observed in a resource-constrained healthcare system were comparable to other larger centers specifically for stone clearance and complication rates.

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