Section: Urology

Original Research Article

A RETROSPECTIVE STUDY EVALUATING THE S.T.O.N.E NEPHROLITHOMETRY SCORE IN PREDICTING STONE CLEARANCE AFTER PERCUTANEOUS NEPHROLITHOTOMY AT A TERTIARY CARE CENTRE

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Received *: 08/05/2026*
Received in revised form *: 25/06/2026*
Accepted *: 10/07/2026*

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DOI: 10.70034/ijmedph.2026.3.183

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 1143-1151

ABSTRACT

Background: Aim: To predict stone clearance rates in patients who underwent Percutaneous Nephrolithotomy by using "S.T.O.N.E. Nephrolithometry Score".

Materials and Methods: This is a retrospective observational study. The study was conducted in the department of Urology at Guntur Medical College. The study was carried out with the data of people who underwent PCNL within a period of 2 years from April 2024 to March 2026. All patients who underwent percutaneous nephrolithotomy and fulfilled the below mentioned inclusion and exclusion criteria were studied. All consecutive adult patients of renal calculi who were scheduled for PCNL at Government general hospital Guntur, Urology department were included in the study.

Results: A total of 100 patients of renal stones treated by PCNL in the department of Urology at Government general hospital Guntur were selected for this study. We had patients age ranging from 18-70 years with mean age of 46.38 years with SD of 12.385 years. Also, the difference in mean age was not statistically different in between stone free and residual stone group patients. In the present study, equal number of patients involving both sides with no significant difference in their distribution between stone free and residual stone group. We had almost equal number of patients involving both sides with no significant difference in their distribution between stone free and residual stone group. Flank pain was the most common complaint at presentation in our patients. While some had fever, a few patients had hematuria when they presented. All patients were put on prophylactic antibiotic and then taken up for surgery. All patients were evaluated for S.T.O.N.E. score on CT KUB plain. Each criterion is described and correlated with SFR. In our study, tract length ranged from 70 to 140 mm with a mean of 105.44 and S.D. of 19.3mm. Our study had a mean length of 106.5 mm with a SD of 20.4 mm in stone free patients and a mean length of 102.4 mm with a SD of 15.8 mm in residual stone pts. The difference was not statistically significant. Based on the S.T.O.N.E Nephrolithometry score patients were categorised into Low,[5-7] Moderate,[8-10] and High,[11-13] complexity scores. In this study, S.T.O.N.E. score ranged from 5 to 12 with a mean score of 7.6 and S.D. of 1.8. The difference in score was statistically significant for SFR. In our study, minimum hospital stay was 3 days and maximum was 8 days, with an average of 4.9 days. SD was 1.1 days.

Conclusion: The present study concluded that high S.T.O.N.E nephrolithometry score is associated with low stone free rate. Hence S.T.O.N.E nephrolithometry can be used as an assessment tool for predicting the stone free rate.

Keywords: S.T.O.N.E, Percutaneous, nephrolithometry, SFR, Hematuria.

INTRODUCTION

Renal stones are a common problem affecting all population groups across the globe. The true prevalence of stone disease is probably underestimated because many stones remain asymptomatic and consequently go undiagnosed.[1] Nevertheless, the reported prevalence of stone disease is increasing worldwide, including regions that have historically had low rates of urolithiasis.[2] The incidence rate of nephrolithiasis even varies with geographical region of an individual country. Studies have estimated the prevalence of urinary stones to be 4% to 15% among the general population.[3] A population based study in Northern India found the lifetime prevalence of urinary stones to be 7.9%.[4] Despite the variety of preventive medical management and intervention tools, nephrolithiasis is largely a recurrent disease with a relapse rate of approximately 50% in 5–10 years and 75% in 20 years.[5] The rate of recurrence of renal calculi in patients after 1st time occurrence is 14% at 1st year, 35% in 5th year and 52% in 10th year.[6]

In 1979 Arthur Smith defined the term endourology as closed controlled manipulation within the genitourinary tract. The era of open pyelolithotomy has passed and nowadays there are much less invasive treatments, such as Percutaneous Nephrolithotomy (PCNL), Ureteroscopy (URS), and Shockwave lithotripsy (SWL).

Percutaneous extraction of renal stone – properly termed percutaneous nephrolithotomy (PCNL) was first described over four decades ago.[7] Over the years, it has become the preferred method for management of majority of renal stones. Indications and limitations of PCNL have been well established with treating large stone burden being its most important indication.[8] PCNL is now recommended for kidney stones larger than 2 cm and for Staghorn Calculi (SC).[9]

Although PCNL is a minimally invasive major operation to treat large renal calculi, it does not always render the patient stone-free. Studies have documented overall stone free rates between 76–84%.[10] Since the original description of this technique, surgical technique has advanced and technology has improved. This has allowed increased effectiveness of PCNL in removal of renal calculi. But still, it continues to be a challenging urological procedure, which if not performed well, can be associated with significant complications.[11-13] This has led to the realization of need for methods to predict success of PCNL.

Past studies have analysed various pre- and peri-operative factors such as stone size and configuration, percutaneous access number and location, entry performed by radiologist or urologist, presence of hydronephrosis as predictors of success rates and complications.[14] However, currently, no standardized method is available to predict the stone-free rate after PCNL. There is also heterogeneity in reporting of PCNL outcomes among different centres.[15] This has led to various scoring systems being developed to preoperatively stratify the difficulty of PCNL and allow for better therapeutic decisions. One such system is S.T.O.N.E. Nephrolithometry scoring system.[16] This scoring system assesses PCNL complexity according to five parameters calculated from the non-contrast computerized tomography (NCCT) scan (stone size, tract length, obstruction/hydronephrosis, number of involved calyces, and essence/Hounsfield units (HU)).[16]

In our study, we attempt to stratify patients based on this scoring system and predict for whom stone clearance may not be possible in a single attempt as well as predict risk of complications.

Aims and Objectives

Aim

1. To predict stone clearance rates in patients undergoing Percutaneous Nephrolithotomy by using "S.T.O.N.E. Nephrolithometry Score".

Objective

1. To evaluate S.T.O.N.E. score and its individual components in management of renal calculi with PCNL.
2. To predict intraoperative complexity and postoperative complications of PCNL with S.T.O.N.E. score.
3. To use S.T.O.N.E. score to design and quantify the management of renal calculi.

MATERIALS AND METHODS

Study site

The study was conducted in the department of Urology at Guntur Medical College/GGH, Guntur, Andhra Pradesh, India.

Study population

All patients who underwent percutaneous nephrolithotomy and fulfilled the below mentioned inclusion and exclusion criteria were studied.

Inclusion Criteria

1. All consecutive adult patients of renal calculi who were scheduled for PCNL at Government general hospital Guntur, Urology department were included in the study.

Exclusion Criteria

1. Patients undergone bilateral concomitant PCNL
2. Patients undergone concomitant ureteric calculi management.
3. Patients with chronic kidney disease.
4. Patients with preoperative stenting/ PCN diversion.
5. Second look PCNL while including first PCNL.
6. When percutaneous renal acess obtained by interventional radiologist.

Study Design

This is a retrospective observational study.

Sample Size

The sample size in this study was 100 patients as per the undermentioned formula:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

n=required sample size
t=confidence level at 95% (standard value of 1.96)
p=estimated prevalence
m=margin of error at 5%(standard value of 0.05)

Time frame

The study was carried out with data within a period of 2 years from April 2024 to March 2026.

Data collection technique and tools

Patients who were clinically evaluated according to the proforma attached. Patients were subjected to investigation and surgery as per protocol explained. Patients were followed up to a month postoperatively.

Preoperative evaluation

All patients were evaluated in the outpatient department and plan of surgical management was made based upon the radiological investigations. All selected patients were subjected to routine blood and biochemical examinations, complete urine analysis and urine culture sensitivity and non contrast CT KUB preoperatively. Depending upon the age of patient, other investigations like, electrocardiogram, 2 D-Echo and chest roentgenogram were done to evaluate fitness for surgery. Once admitted for the surgical procedure, detailed history was taken. Complete physical examination was also carried out. The study stresses on preoperative non contrast CT. The characters of the stone and other points mentioned in the S.T.O.N.E criteria [16] are as follows.

1. Stone size (S) – estimated by measurement of length and width
2. Tract length (T) – evaluates on skin-to-stone distance.
3. Obstruction (O) – evaluates the degree of Hydronephrosis
4. Number of involved calices (N) – number of calices involved with stone, and
5. Essence of stone density (E) – according to radiodensity threshold based on Hounsfield units (HU)

Table 1 S.T.O.N.E SCORE[16]

Variables	1	2	3	4
Stone size [mm^2]	0-399	400-799	800-1599	≥1600
Tract length [mm]	≤100	>100		
Obstruction	None/mild	Moderate/ severe		
Number of calyces	2-Jan	3	Complete Staghorn	
Essence[HU]	≤ 950	> 950		

Minimum score based on this study will be 5 and maximum will be 13. Based on the score, stones were categorised into Low,[5-7] Moderate,[8-10] High,[11-13] complexity.

Postoperative:

Hemoglobin and Renal function tests were done on postoperative day 2.

X-Ray KUB/USG KUB were done on $2^{nd}/3^{rd}$ post operative day and SFR was assessed with respect to S.T.O.N.E Score parameter. Stone Free is considered when there is no residual stone or presence of only CIRF's. CIRF's are described as asymptomatic, non-infectious and non-obstructive stone fragments (≤4 mm).[17,18]

Procedure:

All procedures were performed under Spinal or General anaesthesia and C-Arm guidance in prone position. Patients were given loading dose of antibiotic 30 minutes before anaesthesia. Patients were placed in lithotomy position, Cystoscopy was done and ureteric catheter was placed in the ureter of affected side along with placement of 16 French Foleys catheter in the bladder. Patients were then placed in prone position. Retrograde dye study was done for delineating the PCS and puncture(s) was made in the desired calyx(es). Tracts were dilated with Alken metallic co-axial dilators upto 24Fr and Amplatz sheath was passed over it. Nephroscope was introduced and stone was fragmented with Pneumatic lithotripter. Additional tracts were made if clearance was not achieved with single tract. 18/20 Fr Nephrostomy Drainage (ND) tube was placed in the tracts in most of the patients and was secured to skin with silk 2-0 suture. ND tube was omitted in cases with no bleeding, perforation and for whom a second percutaneous procedure was not anticipated. As far as possible, an attempt for complete clearance was done in the first sitting itself. If it was not possible to clear stone completely in single sitting, cases were staged and instead of ND tube, "Re-entry" Malecot catheter was placed. Repeat attempt for complete clearance was done after a few days. DJ stent was placed in all cases.

Post-operative morbidity was assessed looking into following problems

a) Pain [Visual Analog Scale]
b) Hematuria
c) Fever with Urinary tract infection
d) Stent related problems

Complications were graded according to Modified Clavien classification system. [118]

Table 2: Modified Clavien classification system,[19]

Grade	Description
Grade I	Any deviation from the normal post-operative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions (allowed therapeutic regimens are antiemetics, antipyretics, analgesics, diuretics, electrolytes and physiotherapy).

Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications.
Grade IIIa	Requiring surgical, endoscopic or radiological interventions not under general anesthesia.
Grade IIIb	Requiring surgical, endoscopic or radiological interventions under general anesthesia.
Grade IVa	Life-threatening complication requiring Intensive Care Unit management (single organ dysfunction).
Grade IVb	Life-threatening complication requiring Intensive Care Unit management (multiple organ dysfunction).
Grade V	Death of a patient.

On the second/ third post-operative day X-Ray KUB/USG KUB to assess the SFR was done. If residual stones were present, patient and relatives were counselled and 2nd stage surgery was planned if required. In case of complete destoning ND tube was removed. Once leak subsided from ND tube site, Foley's catheter was removed. Patient was discharged once he/she passed urine normally.

Follow Up:

Urine culture and sensitivity was done to rule out Urinary tract infection (UTI) if patient complained of fever, dysuria or pyuria. USG KUB/X-Ray KUB were again taken after 1 month. If no residual stones were found, then stent was removed at the same follow up.

Statistical Methods:

Descriptive statistical analysis was carried out in the study.

Statistical methods used:

Descriptive statistics - Mean, Standard Deviation (SD), Percentages, and Frequencies

Graphs: simple bar diagram, multiple bar diagram, pie diagram

Chi square test: used to check the relation between categorical data.

T-test: used to check the relation between continuous data.

P-value less than 0.05 was considered as significant.

RESULTS

A total of 100 patients of renal stones were treated by PCNL in the department of Urology at Government general hospital Guntur were selected for this study. They were studied and following findings were noted and analyzed.

SFR was the end reference point, evaluated by X-Ray KUB/USG KUB done at POD 2/3. Further USG KUB/X-Ray KUB was taken at the end of 1 month for all patients and destoning assessed.

Stone free rate (SFR): Stone free is defined in our study as Clinically insignificant residual fragments (CIRFs). CIRFs are described as asymptomatic, non-infectious and non-obstructive stone fragments (≤4 mm) which can occur in 70% of patients with large stones undergoing PCNL.[17,18] Rest of the patients were categorised as cases of Residual stone. We have done X-Ray KUB/ USG KUB on 2/3rd post operative day to assess the SFR. 26 of our patients had residual stones.

Table 1: Stone free rate

	Frequency	Percentage
Residual stone	26	26
Stone free	74	74

Age: We had patients age ranging from 18-70 years with mean age of 46.38 years with SD of 12.385 years. Also, the difference in mean age was not statistically different in between stone free and residual stone group patients.

Table 2: Age distribution

Age(years)	Frequency	Percentage
11-20	2	2.0
21-30	6	6.0
31-40	22	22.0
41-50	34	34.0
51-60	20	20.0
>61	16	16.0

Table 3: Comparison of mean age in stone free and residual stone patients

	Mean Age (years)	SD	P value
Stone free patients	46.8	12.8	0.649
Residual stone patients	45.1	11.5	

Gender: We had almost equal distribution of both genders in our study and there was no statistically significant difference in between stone free and residual stone group.

Table 4: Gender Distribution

Sex	Frequency	Percentage
Male	44	44
Female	56	56

Table 5: Gender distribution in stone free and residual stone patients

	Overall n (%)	Stone free patients	Residual stone patients	p value
Male	44 (44)	32 (72.73)	12 (27.27)	0.856
Female	56 (56)	42 (75)	14 (25)	

Stone laterality: We had almost equal number of patients involving both sides with no significant difference in their distribution between stone free and residual stone group.

Table 6: Stone laterality

	Frequency	Percentage
Right	54	54
Left	46	46

Table 7: Stone laterality distribution in stone free and residual stone patients

	Overall n (%)	Stone free patients	Residual stone patients	p-value
Right	54 (54)	40 (74.07)	14 (25.93)	0.990
Left	46 (46)	34 (73.91)	12 (26.09)	

Clinical presentation: Flank pain was the most common complaint at presentation in our patients. While some had fever, a few patients had hematuria when they presented. All patients were put on prophylactic antibiotic and then taken up for surgery.

Past history: Twenty six of our patients had previous history of stone disease and twenty four patients had history of previous urological intervention.

Table 8: Past history

Past history	Yes/No	Frequency	Percentage
Stone disease	Yes	26	26
	No	74	74
Lithuria	No	100	100
	Yes	0	0
Uro intervention	No	76	76
	Right URSL+DJ stenting	2	2
	Left URSL+DJ stenting	4	4
	Open pyelolithotomy	2	2
	PCNL	10	10
	Nephrolithotomy	2	2
	ESWL	4	4

S.T.O.N.E Score: All patients were evaluated for S.T.O.N.E. score on CT KUB plain. Each criterion is described and correlated with SFR.

Stone size: It was calculated by multiplying maximum length and maximum width in square millimetres (mm ^{2}). Stones less than 400 mm ^{2} were partial staghorn stones as they did not occupy entire pelvicalyceal system as per the definition of staghorn stone.[22] Stone size ranged from 150 to 2400 mm^2 with a mean size of 539.36 mm^2 and standard deviation (S.D.) of 431.66 mm^2. Mean stone size in stone free patients was 390 square mm with SD of 195 square mm and mean stone size was 965 square mm with SD of 617 square mm in residual stone patients. Stone size was a significant factor in predicting SFR.

Table 9: Stone size

Stone size (square mm)	Overall n (%)	Stone free patients	Residual stone patients	p value
0 - 399	50 (50)	46 (92)	4 (8)	**0.003**
400 - 799	32 (32)	22(68.8)	10 (31.3)	
800 – 1599	14 (14)	6 (42.9)	8 (57.1)	
>1600	4 (4)	0 (0)	4 (100)	
Mean size	539.36 ± 431.66	390 ± 195	965 ± 617	**0.006**

Tract length: It is the skin-to-stone distance which is defined as the mean vertical distance from the centre of the stone to the skin measured on a supine CT KUB plain film at 0º, 45º, and 90º measured in mm.

In our study, tract length ranged from 70 to 140 mm with a mean of 105.44 and S.D. of 19.3mm. Our study had a mean length of 106.5 mm with a SD of 20.4 mm in stone free patients and a mean length of 102.4 mm with a SD of 15.8 mm in residual stone pts. The difference was not statistically significant.

Table 10: Tract length

Tract length (mm)	Overall n (%)	Stone free patients	Residual stone patients	p value
≤100	42 (42)	30 (71.4)	12 (28.6)	0.724
>100	58 (58)	44 (75.9)	14 (24.1)	
Mean length	105.44 ± 19.3	106.5 ± 20.4	102.4 ± 15.8	0.461

Obstruction: It is thepresence of hydronephrosis**.** Almost half the number of patients had moderate to severe obstruction in our study. Although success rate was higher in patients with no to mild hydronephrosis, the difference was not statistically significant.

Table 11: Obstruction

Obstruction	Overall n (%)	Stone free patients	Residual stone patients	p value
No/Mild	54 (54)	44 (81.5)	10 (18.5)	0.191
Moderate/ Severe	46 (46)	30 (65.2)	16 (34.8)	

Number of calyces involved: This denotes the number of calyces containing stones. A maximum score of 3 is assigned if a complete SC is present. In our study, mean number of calyces involved in stone free patients was 1.135 with SD of 0.347 whereas the mean number of calyces involved in residual patients was 1.692 with SD of 0.855. The difference in mean number of calyces was approaching statistical significance. Further, when number of calyces were studied by dividing into categories of S.T.O.N.E. score, the difference was statistically significant.

Table 12: Number of calyces involved

Number of calyces involved	Overall n (%)	Stone free patients	Residual stone patients	p value
1-2	78 (78)	64 (82.1)	14 (17.9)	**0.006**
3	16 (16)	10 (62.5)	6 (37.5)	
Staghorn	6 (0.8)	0 (0)	6 (100)	
Mean	1.28 ± 0.57	1.135 ± 0.35	1.692 ± 0.85	0.057

Essence: This is the stone density, measured in HU. In our study, we had patients with a minimum of 500 HU to a maximum of 1800 HU with a mean of 1020 HU. Although mean HU in residual stone patients was slightly higher than in stone free patients the difference was not found to be statistically significant.

Table 13: Essence

Essence (HU)	Overall n (%)	Stone free patients	Residual stone patients	p-value
≤950	44 (44)	36 (81.8)	8 (18.2)	0.264
>950	56 (56)	38 (67.9)	18 (32.1)	
Mean	1019.9 ± 273.1	1010 ± 300	1047 ± 181	0.607

S.T.O.N.E Nephrolithometry Score: Based on the S.T.O.N.E Nephrolithometry score patients were categorised into Low,[5-7] Moderate,[8-10] and High,[11-13] complexity scores. In this study, S.T.O.N.E. score ranged from 5 to 12 with a mean score of 7.6 and S.D. of 1.8. The difference in score was statistically significant for SFR.

Table 14: S.T.O.N.E Nephrolithometry Score

S.T.O.N.E Score	Overall n (%)	Stone free patients (%)	Residual stone patients (%)	p value
Low complex (5 – 7)	48 (48)	44 (91.7)	4 (8.2)	**0.001**
Moderate complex (8 –10)	46 (46)	30 (65.2)	16 (34.8)	
High complex (11 – 13)	6 (6)	0 (0)	6 (100)	

Table 15: S.T.O.N.E Nephrolithometry Score (Mean)

	Overall	Stone free patients	Residual stone patients	p value
Mean score	7.6	7.11	9.00	**0.005**
S.D.	1.761	1.43	1.91	

Table 16: Duration of surgery

Time (min)	Frequency	Percentage
31 – 60	40	40
61 – 90	42	42
>90	18	18

Table 17: Duration of surgery (Mean)

	Mean duration of surgery (min)	SD	p value
Stone free patients	69.3	21.0	0.025
Residual stone patients	91.5	29.9	

Volume of irrigation: This is the quantity ofirrigation fluid (Normal Saline) in millilitres (ml)used during the procedure. We had used a minimum of 3000 ml to a maximum of 20000 ml in our patients with an average of 8830 ml and SD of 4635 ml. Mean volume of irrigation fluid used in residual stone patients was significantly more.

Table 19: Mean Irrigation Volume (ml)

Irrigation (ml)	Overall –Mean (SD)	Stone free patients –Mean (SD)	Residual stone patients –Mean (SD)	p value
	8830 (4635)	7838 (4052)	11654 (5178)	0.028

Duration of hospital stay: In our study, minimum hospital stay was 3 days and maximum was 8 days, with an average of 4.9 days. SD was 1.1 days. Fourteen patients had hospital stay more than 5 days. Our study had a mean duration of hospital stay of 4.73 in Stone free patients with a SD of 0.871 and mean duration of 5.62 with SD of 1.39 in Residual patients. This difference was statistically significant.

Table 20: Duration of hospital stay

Hospital Stay (Days)	No. of Patients	Percentage
≤5	72	72
>5	28	28

Table 21: Mean duration of hospital stay

	Mean duration of surgery (days)	SD	p value
Stone free patients	4.73	0.871	0.048
Residual stone patients	5.62	1.39	

Complication during surgery: Intraoperative bleeding was noticed in 4 patients in our study. No other intraoperative complication was noted during the study period. Correlation with S.T.O.N.E. score could not be done since the number of complications were too less for a meaningful analysis.

Table 22: Complication during surgery

Complication	Frequency	Percentage
No complication	96	96
Bleeding	4	4

Stages of surgery: Twelve patients were planned for second stage of surgery due to the Residual stones. They underwent 2nd stage surgery and all were completely cleared of stone. Ten patients with residual stones were initiated on medical treatment for the stone disease. USG KUB/ X-Ray KUB was done for all the patients after 1 month.

Table 23: Stage of surgery

	Frequency	Percentage
Single stage	88	88
Second stage	12	12

Post operative complications: We had our share of complications. These were graded according to modified Clavien classification. All of them were managed conservatively. None of our patients required any surgical intervention. Sixty six percent patients did not have any complications, which included a case of high complexity score. Four patients with low complexity score, eight patients with moderate complexity score and two patients with high complexity score had grade 2 complications. Overall, the differences were not statistically significant.

Table 24: Post operative complications

Clavien Grade	Complication	Number (%)
0	None	66 (66)
1	Persistent pain	6 (6)
	Fever managed with routine antibiotics	14 (14)
2	Fever requiring additional antibiotics	8 (8)
	ND tube leakage <24 hours	6 (6)

Table 25: Correlation of Clavien grade with S.T.O.N.E. score

S.T.O.N.E. score	Overall (%)	Clavien Grade			
		0	1	2	p-value
Low	48 (48%)	38 (79.2%)	6 (12.5%)	4 (8.3%)	0.362
Moderate	46 (46%)	26 (56.5%)	12 (26.1%)	8 (17.4%)	
High	6 (6%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	

FOLLOW-UP: After 1 month, destoning was assessed with USG KUB/X-Ray KUB. Twelve out of fourteen patients with residual stones who were managed conservatively had residual stone at one month. All of our patients who underwent 2nd stage surgery had no residual stones.

Table 26: Residual stone

Stone free	Frequency	Percentage
Stone free	88	88
Residual stone	12	12

DISCUSSION

Renal stones are a common problem globally. PCNL is a well-established treatment for complex, large and staghorn stones. Before the surgical treatment of renal stones, a thorough medical history and physical examination, proper imaging studies, and appropriate laboratory tests are necessary in all patients.

Accurate prediction of procedure success helps in counseling of patients and also prepares surgeon for anticipation of any complications. In this regard various scoring systems have been developed, each with its own advantage and disadvantages. S.T.O.N.E. nephrolithometry score is one such scoring system which is based on preoperative CT parameters and easy to apply. This study was undertaken to check the effectiveness of this score in our cohort of patients in predicting SFR as well as complications.

We had 100 patients in our study. SFR was the end reference point. It was defined here as CIRFs i.e. asymptomatic, non-infectious and non-obstructive stone fragments (≤4 mm). All data was correlated with SFR. Complications were graded according to modified Clavien classification and were correlated with S.T.O.N.E. score. We compared our study with related studies of Okhunov Z et al,[16] Farhan M et al,[20] and Kumar U et al.[21]

Our percentage of residual stone patients was high compared to these studies. We included even those patients who underwent second stage procedure into residual stone group, which may have led to the inflated number of residual stone patients. After assessment at one month follow-up, only 12% patients had residual stones.

Overall SFR status

Stone size

Stone size was a significant factor in predicting SFR (p value-0.006). Our results are similar to studies of Okhunov Z et al,[16] Farhan M et al,[20] as well as Kumar U et al.[21] Various studies done in past also found stone size to be significantly correlated with SFR.

Stone size (mm^2)

Tract length

The tract length evaluates the skin-to-stone distance. There was no significant association with SFR (p value-0.461). This result was also consistent with findings of Okhunov Z et al (p value-0.27),[16] Farhan M et al (p value-0.306),[20] as well as Kumar et al (p value=0.62).[21]

Obstruction

Obstruction is the third variable; it evaluates the presence of hydronephrosis. We did not have a statistical significance associated with presence of obstruction with SFR (p value-0.191). The results were similar to previous studies

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Number of Calyces

The number of calyces containing stones is the fourth variable. This criterion was found to be statistically significant in correlation with SFR. Although Farhan M et al,[20] did not find it to be significant predictor of SFR, our results were corroborated by Okhunov Z et al,[16] and Kumar U et al.[21]

Essence

The fifth criterion is the essence of the stone measured in HU. Our study did not have statistical

significance (p value-0.607) similar to results of Okhunov,[16] and Farhan,[2]

S.T.O.N.E Nephrolithometry Score

Overall S.T.O.N.E Nephrolithometry score was significantly associated with the SFR in our study (p value-0.001). This result was comparable to the findings of Okhunov Z et al (p value-0.01),[16] Farhan M et al (p value-0.02),[20] and Kumar et al (p value <0.01).[21] Besides these, various other studies also corroborate this association.[23,24]

Duration of Surgery

Duration of surgery was 22 min more in patients of residual stone group than Stone free patients, which was statistically significant (p value-0.025). Previous studies also found a statistically significant association of surgical duration with SFR.[16,21,20]

Duration of hospital stay

Duration of hospital stay was higher in patients with residual stone which was also statistically significant. Significant association was seen in studies by Okhunov et al,[16] and Kumar et al,[21]

The prolonged hospital stay could be attributed to two-stage procedure in addition to factors like leak from ND tube site, hematuria or, fever in the post-operative period.

Irrigation

On assessment of the amount of Irrigation in Millilitres (ml) used, we had increased usage of irrigation in the Residual stone patients compared with stone free patients. This was statistically significant (p value-0.00). This suggests that more complex stones require more amount of irrigation fluid.

Complications

We did not find any statistically significant association of modified Clavien grade with STONE score. Although similar to our results Farhan et al also did not find significant correlation, Kumar et al in their prospective study did find a correlation with STONE score. This result may be due to less number of patients in our study.

CONCLUSION

High S.T.O.N.E nephrolithometry score is associated with low stone free rate. Hence S.T.O.N.E nephrolithometry can be used as an assessment tool for predicting the stone free rate.Although we did not find correlation of complications with the score, larger studies are needed to validate the above results.S.T.O.N.E nephrolithometry score is a simple scoring system which can be used as an adjunct for surgical planning.

Conflict of Interest: None

Funding Support: Nil

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